CHARLES G. ATKINS
Pioneer American Fish Culturist
Commissioner of Fisheries of Maine 1867-1871
In U. S. Fisheries Service Continuously from July, 1872, to Date
Corresponding Secretary of American Fisheries Society 1904-1910
Born January 19, 1841

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

FORTY-FIRST ANNUAL MEETING

OCTOBER 3, 4, AND 5, 1911

AT

ST. LOUIS, MO.

WASHINGTON
PUBLISHED BY THE SOCIETY
1912

Officers

1910—1911

Elected at the Fortieth Anniversary Meeting in New York City for the following year, including the meeting held in St. Louis, Mo., October 3, 4, and 5, 1911.

President............................W. E. Meehan, Harrisburg, Pa.
Vice-President......................S. F. Fullerton, St. Paul, Minn.
Recording Secretary..............Ward T. Bower, Washington, D. C.
Assistant Recording Secretary...Ethel M. Smith, Washington, D. C.
Corresponding Secretary.........Hugh M. Smith, Washington, D. C.
Treasurer............................C. W. Willard, Westerly, R. I.

Vice-Presidents of Divisions

Fish Culture..................Charles G. Atkins, East Orland, Me.
Aquatic Biology and Physics.Barton W. Evermann, Washington, D. C.
Commercial Fishing.............John W. Titcomb, Lyndonville, Vt.
Angling............................John E. Gunckel, Toledo, Ohio
Protection and Legislation....Theodore S. Palmer, Washington, D. C.

Executive Committee

Charles H. Townsend, *Chairman*, New York City; Geo. T. Mathewson, Thompsonville, Conn.; Jabe Alford, Madison, Wis.; Henry B. Ward, Urbana, Ill.; Daniel B. Fearing, Newport, R. I.; D. H. Power, Suttons Bay, Mich.; John P. Babcock, San Francisco, Cal.

1911-1912

Elected at the Forty-first Annual Meeting in St. Louis, Mo., for the ensuing year, including the meeting to be held in Denver, Colo., beginning September 3, 1912.

President............................S. F. Fullerton, St. Paul, Minn.
Vice-President................Charles H. Townsend, New York City
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Vice-Presidents of Divisions

Fish Culture......................John W. Titcomb, Lyndonville, Vt.
Aquatic Biology and Physics......Dr. Edwin Linton, Washington, Pa.
Commercial Fishing..............A. B. Alexander, Washington, D. C.
Angling..............................H. Wheeler Perce, Chicago, Ill.
Protection and Legislation........Dr. T. S. Palmer, Washington, D. C

Executive Committee

Dr. Henry B. Ward, *Chairman*, Urbana, Ill.; Daniel B. Fearing, Newport, R. I.; E. Hart Geer, Hadlyme, Conn.; D. H. Power, Suttons Bay, Mich.; A. R. Whitaker, Phoenixville, Pa.; R. Tyson White, Brooklyn, N. Y.; W. L. May, Denver, Colo.

AMERICAN FISHERIES SOCIETY

Organized 1870

The first meeting of the Society occurred December 20, 1870. The organization then effected continued until February, 1872, when the second meeting was held. Since that time there has been a meeting each year, as shown below. The respective presidents were elected at the meeting, at the place, and for the period shown opposite their names, but they presided at the subsequent meeting.

PRESIDENTS, TERMS OF SERVICE, AND PLACES OF MEETING

1. William Clift.........1870-1872....New York, N. Y.
2. William Clift.........1872-1873....Albany, N. Y.
3. William Clift.........1873-1874....New York, N. Y.
4. Robert B. Roosevelt..1874-1875....New York, N. Y.
5. Robert B. Roosevelt..1875-1876....New York, N. Y.
6. Robert B. Roosevelt..1876-1877*...New York, N. Y.
7. Robert B. Roosevelt..1877-1878....New York, N. Y.
8. Robert B. Roosevelt..1878-1879....New York, N. Y.
9. Robert B. Roosevelt..1879-1880....New York, N. Y.
10. Robert B. Roosevelt..1880-1881....New York, N. Y.
11. Robert B. Roosevelt..1881-1882....New York, N. Y.
12. George Shepard Page.1882-1883....New York, N. Y.
13. James Benkard........1883-1884....New York, N. Y.
14. Theodore Lyman......1884-1885....Washington, D. C.
15. Marshall McDonald...1885-1886....Washington, D. C.
16. W. M. Hudson........1886-1887....Chicago, Ill.
17. William L. May.......1887-1888....Washington, D. C.
18. John H. Bissell.......1888-1889....Detroit, Mich.
19. Eugene G. Blackford..1889-1890....Philadelphia, Pa.
20. Eugene G. Blackford..1890-1891....Put-in Bay, Ohio.
21. James A. Henshall....1891-1892....Washington, D. C.
22. Herschel Whitaker....1892-1893....New York, N. Y.
23. Henry C. Ford........1893-1894....Chicago, Ill.
24. William L. May......1894-1895....Philadelphia, Pa.
25. L. D. Huntington......1895-1896....New York, N. Y.
26. Herschel Whitaker....1896-1897....New York, N. Y.
27. William L. May.......1897-1898....Detroit, Mich.
28. George F. Peabody....1898-1899....Omaha, Nebr.
29. John W. Titcomb.....1899-1900....Niagara Falls, N. Y.
30. F. B. Dickerson.......1900-1901....Woods Hole, Mass.
31. E. E. Bryant..........1901-1902....Milwaukee, Wis.
32. George M. Bowers....1902-1903....Put-in Bay, Ohio.
33. Frank N. Clark.......1903-1904....Woods Hole, Mass.
34. Henry T. Root........1904-1905....Atlantic City, N. J.
35. C. D. Joslyn..........1905-1906....White Sulphur Springs, W. Va.
36. E. A. Birge...........1906-1907....Grand Rapids, Mich.
37. Hugh M. Smith.......1907-1908....Erie, Pa.
38. Tarleton H. Bean.....1908-1909....Washington, D. C.
39. Seymour Bower.......1909-1910....Toledo, Ohio.
40. William E. Meehan...1910-1911....New York, N. Y.
41. S. F. Fullerton........1911-1912....St. Louis, Mo.

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*A special meeting was held at the Centennial Grounds, Philadelphia, Pa., October 6 and 7, 1876.

CERTIFICATE OF INCORPORATION OF THE AMERICAN FISHERIES SOCIETY

We, the undersigned, persons of full age and citizenship of the United States, and a majority being citizens of the District of Columbia, pursuant to and in conformity with sections 599 to 603, inclusive, of the Code of Law for the District of Columbia enacted March 3, 1901, as amended by the Acts approved January 31 and June 30, 1902, hereby associate ourselves together as a society or body corporate and certify in writing:

1. That the name of the Society is the AMERICAN FISHERIES SOCIETY.

2. That the term for which it is organized is nine hundred and ninety-nine years.

3. That its particular business and objects are 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; to unite and encourage all interests of fish culture and the fisheries; and to treat all questions of a scientific and economic character regarding fish; with power:

a. To acquire, hold and convey real estate and other property, and to establish general and special funds.

b. To hold meetings.

c. To publish and distribute documents.

d. To conduct lectures.

e. To conduct, endow, or assist investigation in any department of fishery and fish-culture science.

f. To acquire and maintain a library.

g. And, in general, to transact any business pertinent to a learned society.

4. That the affairs, funds and property of the corporation shall be in general charge of a council, consisting of the officers and the executive committee, the number of whose members for the first year shall be seventeen, all of whom shall be chosen from among the members of the Society.

Witness our hands and seals this 16th day of December, 1910.

Seymour Bower	(Seal)
Theodore Gill	(Seal)
William E. Meehan	(Seal)
Theodore S. Palmer	(Seal)
Bertrand H. Roberts	(Seal)
Hugh M. Smith	(Seal)
Richard Sylvester	(Seal)

CONTENTS

PART I

BUSINESS SESSIONS

Transactions of the American Fisheries Society

Forty-first Annual Meeting, held at the Planters' Hotel, St. Louis, Mo., Tuesday, Wednesday, and Thursday, October 3, 4, and 5, 1911.

Tuesday, October 3, 1911

Meeting called to order by the President, Mr. W. E. Meehan, at 10.00 a.m.

Mr. L. A. Geserich: Mr. President and Gentlemen of the American Fisheries Society, the state of Missouri and the Fish Commission appreciate the fact that you hold your 1912 meeting in St. Louis. I am sure you will have a most enjoyable and instructive meeting.

It is now my pleasure and privilege to present to you the Hon. Frederick H. Kreismann, Mayor of St. Louis, who will welcome you. (Applause.)

Hon. Frederick H. Kreismann, Mayor of St. Louis: Gentlemen of the American Fisheries Society, our worthy Fish Commissioner, Mr. Geserich, fully expresses my sentiments, and I know that the citizens of St. Louis are much gratified at your coming to our city to hold your annual meeting.

The work in which you are engaged is one that is not only of great practical benefit to this country, but it provides a permanent opportunity for the men of the nation to enjoy themselves with nature. The propagation and protection of the fish life, of this country is work of most striking importance, and one which the governments, both federal and state, have dealt with most liberally. You represent that industry in its most scientific and highly progressive side; we laymen enjoy the benefit of your work.

St. Louis has a great many enthusiastic fishermen, and I know that they are all glad to receive you and to bid you a hearty welcome, and hope that your proceedings will result in much satisfaction and benefit to yourselves. I thank you for your attention. (Applause.)

PRESIDENT: Mr. Mayor and Gentlemen, I wish to thank you in behalf of the members of the American Fisheries Society for the welcome with which you have greeted us, and to assure you that we are glad to meet in this historic city and to carry out our proceedings here. We are interested in the work of fish culture and we are practical fish culturists. We are interested, therefore, in the work which you are doing in Missouri and the advance which you are making here in fish-cultural work. I believe if you continue to progress as you have done you will, in time, place this state among the leading commonwealths of the United States in fish-cultural work.

We hear, Mr. Mayor, a great deal nowadays of the word "conservation." It is in the mouth of everyone. But when the word "conservation" was mouldering in the dictionary for lack of use, the American Fisheries Society was an active conservationist. We claim to be the original conservationists. Before anyone thought of taking a hand in the preservation of the forests, the purification of the streams or the preservation and increase of natural resources generally, there was a band of men connected with this Society who gathered together to advocate the propagation and protection of fish and the conservation of our fish-food supply. It was like many other things, a big project looked upon with ridicule by some and by others as merely a little trick and not at all practical; but today it is recognized as one of the most important conservation activities of the country.

Let me say to the Society in my own behalf, I welcome you here and hope that our proceedings will be productive of as much good in the future as they have been in the past.

There are a few things of importance which I would like to suggest that we attend to during the convention.

There is great need for a change in the phrasing of Article V, of the Constitution, with respect to the publications and the program. There should be, I think, a slight change in the phraseology of Article II, so as to make a little clearer the eligibility of associations in this organization. At the present time it is very much of a stretch of the phrasing to receive into membership a society as a society. I think it should be considered, and if thought desirable, an amendment should be prepared covering the matter.

It is requested that all in attendance upon the meeting register with the Secretary.

REGISTERED ATTENDANCE

The registered attendance was 35, as follows:

S. P. Bartlett, Quincy, Ill.
Tarleton H. Bean, Albany, N. Y.
W. H. Boardman, Central Falls, R. I.
Ward T. Bower, Washington, D. C.
George T. Bradley, Norwood, Minn.
G. W. N. Brown, Homer, Minn.
W. O. Buck, Neosho, Mo.
E. E. Caldwell, Havana, Ill.
Eben W. Cobb, St. Paul, Minn.
S. W. Downing, Put-in Bay, Ohio.
L. L. Dyche, Pratt, Kan.
Daniel B. Fearing, Newport, R. I.
G. W. Field, Boston, Mass.
S. A. Forbes, Urbana, Ill.
G. H. Garfield, Brockton, Mass.
L. A. Geserich, St. Louis, Mo.
Henry D. Goodwin, Milwaukee, Wis.
George H. Graham, Springfield, Mass
C. W. Greene, Columbia, Mo.
E. T. Grether, St. Louis, Mo.
R. S. Johnson, Washington, D. C.

PHIL. KOPPLIN, St. Louis, Mo.
H. F. MARDORF, St. Louis, Mo.
WILLIAM L. MAY, Denver, Colo.
W. E. MEEHAN, Mt. Airy, Philadelphia, Pa.
H. WHEELER PERCE, Chicago, Ill.
ROBERT K. ROBINSON, White Sulphur Springs, W. Va.
W. T. THOMPSON, Fairport, Iowa.
FRANK A. TUBBS, Neosho, Mo.
HENRY B. WARD, Urbana, Ill.
ANDREW R. WHITAKER, Phoenixville, Pa.
C. W. WILLARD, Westerly, R. I.
J. S. P. H. WILSON, Auburn, Me.
S. P. WIRES, Duluth, Minn.
STEPHEN G. WORTH, Mammoth Spring, Ark.

NEW MEMBERS

PRESIDENT: We will now receive the applications for membership. The Secretary will read the names.

SECRETARY: The following 51 applications for membership have been submitted:

ARTHUR, S. E., 4345 Washington Ave., St. Louis, Mo.
BALDUS, IGNATZ, 901 Daly St., Indianapolis, Ind.
BORCHERDT, RUDOLPH, Department of Game and Fish, Denver, Colo.
CALDWELL, E. E., Chief Warden and Commissioner, Illinois Fish Commission, Havana, Ill.
CLARK, H. WALTON, U. S. Bureau of Fisheries, Fairport, Iowa.
CLARK, IRA B., U. S. Bureau of Fisheries, Homer, Minn.
CLEVELAND, W. B., Burton, Ohio.
CLUB SHAWINIGAN, Club Shawinigan, St. Maurice Co., Quebec, Canada.
CRASSER, HUGO, U. S. Bureau of Fisheries, Homer, Minn.
DAHL, JOHN, Minnesota Game and Fish Commission, Glenwood, Minn.
DAVIS, FRANK O., State Commissioner of Fisheries and Game, Pomfret Center, Conn.
FREDRUM, JOHN W., 1229 California St., Denver, Colo.
FRENCH, S. L., 1308 Ross Ave., Dallas, Texas.
FULLERTON, WILLIAM ROSS, St. Paul, Minn.
GARFIELD, G. H., Massachusetts Commission on Fisheries and Game, Brockton, Mass.
GEHMAN, CHAS. F., East Greenville, Pa.
GESERICH, L. A., Pres. Missouri State Fish Commission, St. Louis, Mo.
GRETHER, E. T., Chief Deputy Commissioner, Missouri State Game and Fish Department, 1318 Pendleton Ave., St. Louis, Mo.
HAVENHILL, A. D., Fox, Ill.
HEUVER, HARRY J., U. S. Bureau of Fisheries, Duluth, Minn.
*HILL, JOHN F., 136 State St., Augusta, Me.

*Died March 16, 1912.

JOHNSTON, EDWARD C., U. S. Bureau of Fisheries, Washington, D. C.
LAND, S. E., Department of Game and Fish, Denver, Colo.
MCDONALD, CARL K., U. S. Bureau of Fisheries, Neosho, Mo.
MARDORF, H. F., 4068 Olive St., St. Louis, Mo.
MARINE, DR. DAVID, Western Reserve University, Cleveland, Ohio.
MEENTS, R. R., President Illinois Fish Commission, Ashkum, Ill.
MERRIHEW, PERCY T., Neosho, Mo.
MEYER, GUSTAV J. T., 124 South Delaware St., Indianapolis, Ind.
MILES, GEO. W., State Commissioner of Fisheries and Game, Indianapolis, Ind.
MINCH, HARRY C., U. S. Bureau of Fisheries, Fairport, Iowa.
OGELVIE, E. L., Secretary Minnesota State Game and Fish Commission, South St. Paul, Minn.
PATRICK, W. E., Superintendent of State Fish Hatcheries, Denver, Colo.
PELL, GEO. W., 520 Sixteenth St., Denver, Colo.
POHOQUALINE FISH ASSOCIATION, Fifteenth and Walnut Sts., Philadelphia, Pa.
ROTE, E. E., U. S. Bureau of Fisheries, Homer, Minn.
RUCKMAN, CHAS. W., U. S. Bureau of Fisheries, Homer, Minn.
SCHMITT, WALDO, U. S. Bureau of Fisheries, Washington, D. C.
SHINN, JAMES A., Department of Game and Fish, Denver, Colo.
SHIRA, AUSTIN F., U. S. Bureau of Fisheries, Homer, Minn.
SMITH, EMMETT VANCE, Chief Deputy, State Game, Fish and Oyster Commission, Box 217 Capitol Sta., Austin, Texas.
SOUTHALL, JOHN B., U. S. Bureau of Fisheries, Fairport, Iowa.
STERETT, W. G., State Game, Fish and Oyster Commission, Port Lavaca, Texas.
SWIFT, H. F., 307 Crocker Building, San Francisco, Cal.
TONGUE, LEONARD M., U. S. Bureau of Fisheries, Washington, D. C.
VALETTE, LUCIANO H., Chief of Section of Fish Culture, 827 Rivadavia, Buenos Aires, Argentina.
VIQUESNEY, J. H., State Game and Fish Warden, Belington, W. Va.
WALKER, DR. H. T., 210 Main St., Denison, Texas.
WIDMYER, EDGAR R., U. S. Bureau of Fisheries, Homer, Minn.
WILSON, J. S. P. H., Chairman Board of Inland Game and Fish Commissioners, Auburn, Me.
WORTH, HENRY B., U. S. Bureau of Fisheries, Washington, D. C.

Motion made, seconded and unanimously carried electing and admitting to membership in the Society all applicants whose names were read by the Secretary.

PRESIDENT: It is desired that the members of this Society visit the hatchery ponds of the state of Missouri in the park today. We can go by trolley, and I would like to know how many who are present are ready to go this afternoon. The plan is to go at the close of the session. (All signified their intention of going.)

MR. GESERICH: What time do we adjourn this afternoon?

PRESIDENT: If the Society agrees, we will adjourn early, about 4 o'clock, and you can let us know after the session what time you wish us to go.

The next order of business is the report of officers; the first being the report of the President. In my preliminary remarks I made a few suggestions I had in the way of a report.

There are one or two committees that I will announce at the present time. The others will be announced later.

The Program Committee will be: Prof. L. L. Dyche, of Kansas, Chairman; Dr. S. A. Forbes, of Illinois, and Mr. W. O. Buck, of Missouri.

I have here the list of papers as far as they have been presented, and I suggest that the committee group them, and report immediately after luncheon the titles of papers which are to be read today. I would ask that a report be made at the close or beginning of each session.

Committee on Resolutions: Dr. George W. Field, of Massachusetts, Chairman; Mr. S. G. Worth, of Arkansas, Mr. Daniel B. Fearing, of Rhode Island.

This committee will understand, I suppose, that its duties are not only to receive and pass upon all resolutions that may be presented, but also it has the right to originate resolutions.

The Auditing Committee will be: Dr. S. P. Bartlett, of Illinois, Chairman; Mr. W. T. Thompson, Iowa, and Mr. H. Wheeler Perce, of Chicago.

The report of the Secretary, Mr. Ward T. Bower, was then presented.

REPORT OF THE SECRETARY

Mr. President and Members of the American Fisheries Society:

I have prepared no written report, but I will endeavor to tell you briefly of some of the more important occurrences during the past year which, in my judgment, may be termed to be one of the most important years in the Society's history.

First, mention should be made of the incorporation of the Society under the laws of the District of Columbia. Some will recall that this matter of incorporation has been coming up for quite a number of years, including the meeting at New York last year. As a result, we looked into the laws of a number of the states and finally, upon an examination of the code of the District of Columbia, found that the laws there were well suited to our purposes. It is provided by the code of the District that any five persons, a majority of whom shall be legal residents, may have the privilege of incorporating for the conduct of business pertinent to a learned society.

Largely through the efforts of Dr. H. M. Smith, articles of incorporation were drawn under date of December 16, 1910, setting forth the name, objects and purposes of the Society. They were recorded April 15, 1911. As the report of the last meeting did not appear until after the articles of incorporation were complete, it was possible to print the copy in the proceedings, and this was done, the idea being to continue it each year.

It will be noted that there were seven signers of the articles, five of whom are legal residents of the District of Columbia. It was thought proper to add the name of Mr. Seymour Bower, who presided at the meeting in New York when the matter came up, and also the name of Mr. W. E. Meehan, who held the office of President during the current year, thus making seven in all.

Another matter, decidedly in the nature of an innovation, has been the adoption of a membership certificate. This has been possible through the generosity of one of our members, the Hon. Daniel B. Fearing, of Newport, R. I., who stood the entire expense. The work was done by Tiffany & Company, of New York. One of these handsome certificates was mailed to each new member elected at the last meeting. They were letterd by a draftsman at a cost of about 30 cents each.

As an appropriate addition to the certificate of membership the old seal of the Society has been revived. It was originally a conventional design of three crossed fishes which did not represent any particular species. They looked more like mackerel than anything else; but inasmuch as when the Society was founded its members were interested primarily in brook trout, we thought it advisable to have a likeness of the *fontinalis* appear on the new seal. The date of organization, 1870, appears, likewise the date of incorporation, 1910.

Never before has the Society attempted the publication of so elaborate a report as the one appearing since the last meeting, it being a book of nearly 500 pages, and containing 13 cuts and 43 papers, together with the usual discussions of papers and records of the business sessions. A total of 800 copies were printed by the W. F. Roberts Company, of Washington, D. C., the cost being about $1,200, or nearly $1.50 a volume. To this must be added the 20 cents for postage or express on each copy sent out. We have been selling a number of copies at $1 each, although possibly we have not the authority of the Society to do so. A new price ought to be fixed this session. I think the last ruling in the matter permitted the sale at the rate of 50 cents; however, we thought we were justified, in view of the outlay for the volume, in asking a dollar for any of the copies sold. The matter of publishing this report was entirely under the direction of Dr. Smith. The Recording Secretary assisted, as did also the Assistant Secretary.

It will be noted in the published list of members that efforts have been made to state the date of each member's election to the Society. The list has been revised and corrected as far as possible, and members are asked to aid with any further corrections that may be needed. There are very often changes of address of which the Secretary is not aware.

An inventory of the reports on hand is as follows:

1876	1	1902	8
1888	1	1903	2
1894	1	1904	70
1895	3	1905	3
1896	2	1906	106
1897	2	1907	100
1898	3	1908	125
1899	5	1909	104
1900	6	1910	125
1901	6		

We have been fortunate in receiving donations of some of the rarer volumes. Mr. Fearing and Mr. Jennings have helped us out in this way. We would like to have further donations, that the bound series of reports, authorized at the New York meeting to be prepared and in the hands of the Secretary, may be as complete as possible.

Compared with last year the applications for membership have been few, though about 50 have been received. If the members would work a little more earnestly in this cause, it perhaps might be possible to extend our membership circle considerably. The accession of only 40 or 50 members does not mean any growth in the Society, because there is bound to be depletion in the ranks through death, resignation, and necessary separation for delinquency in payment of dues.

Since the last meeting the death of 10 members has been reported. Following are the names and dates, together with date of election to membership in the Society:

Moses H. Cone, Greensboro, N. C. Died December 8, 1908. Death reported only last year. Elected to membership in 1903.

Frank N. Clark, Northville, Mich. Died December 19, 1910. Elected to membership in 1884.

William Cutler, Comstock Park, Mich. Died December 26, 1909. Elected to membership in 1906.

Howard M. Buller, Bellefonte, Pa. Died December 22, 1910. Elected to membership in 1904.

F. C. Zacharie, New Orleans, La. Died January 6, 1910. Elected to membership in 1904.

J. W. Brackett, Augusta, Me. Died June 24, 1911. Elected to membership in 1910.

E. A. Jaggard, St. Paul, Minn. Died January, 1911. Elected to membership in 1908.

Arthur Sykes, Madison, Wis. Died March 18, 1911. Elected to membership in 1900.

H. D. Chichester, Washington, D. C. Died May 31, 1911. Elected to membership in 1910.

Edward Birbeck, London, England. Died 1908. Elected to membership in 1884.

Four resignations have been received, as follows:

Albert L. Barrows, formerly of Cavite, P. I., now of Nordhoff, Cal. Resigned January 13, 1911. Elected a member in 1908.

Oliver Adams, Toronto, Canada. Resigned July 24, 1911. Elected a member in 1908.

George H. Sherwood, New York City. Resigned July 26, 1911. Elected a member in 1903.

W. A. Leisenring, Mauch Chunk, Pa. Resigned September 26, 1911. Elected a member in 1906.

I might mention in passing that it was necessary for me to be out of the country some four months this summer, and during my absence all the Secretary's matters were carefully looked after by the Assistant Secretary, Miss Ethel M. Smith.

Ward T. Bower,
Secretary.

The Secretary's report was then, by unanimous consent, approved and placed on file.

STYLE OF PUBLICATION OF TRANSACTIONS

Mr. Fearing: May I ask a question in regard to these Transactions, simply as a matter of interest in making the index. I wanted to ask if that last volume of Transactions was intentionally printed with each article ending on one page, and then the following article skipping a whole page.

with the idea of members being able to take out an article without taking any print on the other side; because if that book had been printed in the ordinary method its paging would have been reduced considerably, and would not have cost as much.

SECRETARY: It might have been reduced 30 pages or so.

MR. FEARING: I counted them. It would have reduced it considerably more than 30 pages.

SECRETARY: The preparation of this report, I think, represents the very latest idea in artistic book making.

MR. FEARING: I simply asked, because a great many of the foreign societies publish their transactions in that manner. The idea seems a very good one, for you can take out the article as a separate if so desired.

PRESIDENT: I presume you paid for the blank pages the same as if they were printed.

MR. FEARING: I think there are over 40 such pages.

SECRETARY: Yes, something like 40. A reduced rate was made by the printer for the blank pages which appear in the report. The work was under the direction of the chairman of the Publication Committee, Dr. H. M. Smith, who has charge of the preparation of the federal publications on similar matters. I believe the expense was fully justified, and that anyone who examines the book critically will be of the same opinion.

Referring to Mr. Fearing's remarks, we could have at the immediate conclusion of a paper started in with another title, but that would not have been a fair sample of the up-to-date book-maker's art.

MR. FEARING: I thought the idea was to take separate articles out, and if so I think it is a very advisable method to pursue.

SECRETARY: That was the principal idea in view.

TREASURER: Our Secretary states that the expense of getting out this report was about $1,200. I think that the cost of stenographic work at the meetings should be included as part of the expense of getting out the reports. It is quite necessary that the meetings be reported by a stenographer in order that the discussions may be made a part of the printed Transactions. It is logical that this item should go in as part of the expense. Therefore this year the report actually cost us nearly $1,500 instead of $1,280.

SECRETARY: That charge may be very properly included as part of the expense of getting out the Transactions.

TREASURER: My reason for making these remarks is that the members who do not pay their dues promptly may understand the heavy annual expense of getting out this report; and when the Society is obliged to pay $1,500 for 800 reports, it will be seen that the cost is nearly $2 a volume. Every member ought to realize this, and should be more than willing to pay his dues. He certainly gets in the document value received for his dues.

SECRETARY: You want to remind members to pay up their dues?

TREASURER: Yes.

PRESIDENT: We will now have the report of the Treasurer.

At the request of Mr. Willard the report was then read by the Secretary.

REPORT OF THE TREASURER

To the American Fisheries Society:

I herewith present my annual report as Treasurer from September 27, 1910, to October 3, 1911.

RECEIPTS

1910			
Sept. 27.	Balance cash on hand	$222.79	
	Reports sold	17.00	
	Dues and admission fees	862.00	
			$1,101.79

EXPENDITURES

1910		
Sept. 27.	Sundry expenses New York meeting	$ 3.90
" 28.	B. W. Evermann	1.25
" 28.	Ward T. Bower, Sec., postage, etc.	19.80
Oct. 8.	Seymour Bower, postage, etc.	28.44
" 8.	Irving Press, programs, etc.	49.40
" 15.	Stamped envelopes	10.72
" 31.	W. F. Roberts Co., printing	15.25

Nov. 12.	C. J. Butler, envelopes	$10.72	
" 15.	Goodwin & McDermott, stenographers	196.40	
Dec. 2.	W. F. Roberts Co., printing	7.25	
1911			
Jan. 1.	Postage stamps	1.00	
May 16.	Ward T. Bower, Sec., postage, etc.	18.45	
June 7.	W. F. Roberts Co., annual reports	1,280.64	
" 28.	500 stamped envelopes	10.72	
" 28.	Dr. H. M. Smith, postage	5.00	
July 17.	500 circular letters, by Treas.	1.50	
Sept. 8.	Dr. H. M. Smith, postage	5.00	
		$1,665.44	
1911			
Oct. 3.	Balance due Treasurer		$563.65
			$1,665.44

Respectfully submitted,

C. W. WILLARD, *Treasurer.*

WESTERLY, R. I., October 3, 1911.

The report was duly received and referred to the Auditing Committee.

PRESIDENT: The next subject will be reports of Vice-Presidents of divisions.

SECRETARY: Dr. Evermann states that he will have no report available this year concerning the division of aquatic biology and physics. Mr. Gunckel advises that he will be here before the close of the meeting and will present a report on angling. I talked with Dr. Palmer two or three days ago, and he said that he had some items which he wanted to present to the Society on the subject of protection and legislation. The material will be submitted as a paper for publication in the next report, provided such action is agreeable to the Society. The topic proposed by Dr. Palmer is of timely interest, referring as it does to the action of various states in the licensing of hook and line fishing.

PRESIDENT: We will take up the reports later on if any are ready for presentation.

The Executive Committee, of which Dr. Charles H. Townsend is chairman, is next called upon for a report. Is there any other member that can make a report for the committee, in the absence of Dr. Townsend? Dr. Ward, have you anything to say about the Executive Committee's work during the year?

Dr. Henry B. Ward, Urbana, Ill.: I am not aware of any business to report, Mr. President.

President: Mr. Fearing, have you anything to say in reference to the work of the Executive Committee during the year?

Mr. Fearing: I saw Dr. Townsend and he said there was nothing. He will not be here.

President: Will the chairman of the Program Committee report the titles of any papers that may be read before noon?

Prof. L. L. Dyche, Pratt, Kan.: We have not had opportunity for a conference, but I see no reason why if we have time we should not begin the reading of papers.

President: Will the committee get together and recommend some papers to be read before the close of the morning session? I would suggest that while we think about it, some one make a motion as to the time we shall convene after luncheon.

Secretary: Would not 2 o'clock be a suitable time? Judging by the experience of previous meetings this seems to be the usually accepted hour.

President: I might say that, as in the past, it will be considered in order at any time when actual business is not in progress for the Committee on Resolutions to present a report. Between the reading of papers or at any other time during the sessions, that committee has priority over other matters.

The Program Committee has made a preliminary report and I have been called upon to open the skirmish. (At the President's request Mr. Boardman took the chair.)

The President then read a paper on the subject of "Goitre Among Trout, and Efforts to Eradicate It," which paper was discussed.

A recess was taken until 2.00 p.m., same day and place.

At 2.00 p.m. meeting called to order by the President.

Dr. S. P. Bartlett, Quincy, Ill.: My object in asking your attention for a moment is to announce that my colleague, Mr. E. E. Caldwell, of the Illinois Fish Commission, is here and tells me that the steamer *Illinois* is now at the wharf, and that if desired there will be plenty of time to hold a meeting on the boat while running to Alton and back. On behalf of the Illinois Fish Commission Mr. Caldwell tenders the use of the steamer for that purpose.

President: A meeting on the boat will be very pleasant, and in the absence of any objection we accept with thanks Mr. Caldwell's very kind offer. Two o'clock will be a suitable time for starting.

Mr. E. E. Caldwell, Havana, Ill.: Any time that meets with your convenience will suit us. Please come to the foot of Franklin Avenue, just above Eades Bridge.

President: The meeting tomorrow afternoon will be held on board the steamer *Illinois*. We will meet there at 2 o'clock.

Dr. Tarleton H. Bean, New York: I move that the thanks of the Society be extended to the Commissioner of Illinois for his courteous invitation.

Motion seconded and unanimously carried by rising vote amidst applause.

The Secretary then read an invitation for the Society to visit the Merchants' Exchange of St. Louis.

President: I will announce my committees.

Nomination Committee: Dr. Tarleton H. Bean, New York, Chairman; A. R. Whitaker, Pennsylvania; W. H. Boardman, Rhode Island; R. K. Robinson, West Virginia; S. P. Wires, Minnesota.

Committee on Time and Place of Meeting: S. W. Downing, Ohio; W. L. May, Colorado; Dr. Henry B. Ward, Illinois.

Publication Committee: Dr. H. M. Smith, Washington, D. C.; Ward T. Bower, Washington, D. C.; Miss Ethel M. Smith, Washington, D. C.

The Secretary then read several communications extending formal invitation to hold the next annual meeting at Boston, New York, Portland, Oregon, and San Francisco. These communications were referred to the Committee on Time and Place of Meeting.

PRESIDENT: We will proceed with the reading of papers, first hearing from the Program Committee, of which Professor Dyche is chairman.

PROFESSOR DYCHE: The Program Committee has selected three numbers for this afternoon; first we will hear Mr. D. B. Fearing's remarks on a proposed index to the Society's Transactions. We will then have the paper entitled: "Is Irrigation Detrimental to Fish Culture," by Mr. W. T. Thompson, U. S. Bureau of Fisheries, Fairport, Iowa. This will be followed by a paper on the subject: "Utilization of the Dogfish," by Dr. George W. Field, Boston, Mass. These three offerings are selected for the meeting this afternoon.

PRESIDENT: We will hear from Mr. Fearing first.

INDEX OF THE TRANSACTIONS

MR. FEARING: In the Assistant Secretary's report at the last meeting of this Society he suggested that "in view of the scarcity of the early reports, a card index embracing the history of the connection with the Society of both past and present members would be a most valuable adjunct to the records. The careful compilation of such an index, covering the entire period of the Society's existence, would probably cost from $25.00 to $50.00." This matter of an index was later discussed, bringing out the fact that an *author's* index had been worked up by Mr. Bower, and this was later published in connection with his article on the History of the Society, which appears in the volume of the Transactions of the fortieth meeting in 1910.

Mr. Titcomb, Mr. Meehan and others were ready to give their share toward the publication of a proper index of *subjects* as well as of authors, and it was decided that it should be made on cards, and later published so that members might have copies. Mr. Clark moved that a committee be appointed to report at the next meeting in regard to the probable cost of compiling such an index as was proposed. At this point, knowing something of the need and uses of indexes of reference, and having an almost complete set of the Society's Transactions, I innocently offered to have the index made and have enough copies printed to send one to each member of the Society. Upon a motion previously before the Society, it was voted that Dr. Smith be made chairman of a committee, the Secretary, Mr. Titcomb and myself to make up the members, and my offer was accepted with thanks.

On going over my set of the Transactions I discovered that I lacked Volume VIII as well as the first five volumes, but these were kindly loaned to me by the Bureau of Fisheries. Since then I have obtained all except the first and eighth, and once more I will say that I shall be very glad to pay any price within reason for these two.

The work of making an index of the Transactions of this Society as full and as detailed as seems desirable has proved to be a "big job," as Mr. Titcomb prophesied—and I can, after the lapse of a year, only report progress, and not produce the finished product as I had hoped to be able to do.

The Transactions, including those of the last meeting, have been indexed fully by author, subject, and title, and between 800 and 1,000 entries made. Before compiling this index, however, preparatory to its publication, a great many questions and problems have arisen that it would seem well to have the members themselves discuss and offer their own answers and solutions for.

My librarian, who has done the indexing, has made out a list of questions which I will ask you to discuss as fully as time will permit. I shall be very glad to consider any suggestions of changes or improvements offered by members who have used, or tried to use, the Society's publications for reference purposes.

The first question is: Shall the titles of the papers presented at the different meetings be indexed under the first word not an article? For example, the paper, "Some of the Difficulties Encountered in Collecting Pike Perch Eggs" would ordinarily be put under the head of Pike Perch.

PROFESSOR DYCHE: It seems to me that the rules that are followed in ordinary library indexing might very well be followed in indexing these reports.

SECRETARY: In my opinion the ordinary principles of indexing should be applied. Poole's Index or any standard index would be a good pattern. Take, for instance, the paper referred to on "Some of the Difficulties Encountered in the Collection of Pike Perch Eggs," it would be rather unusual to index it under the letter "S" simply because it is the first letter of the title. The subject matter should be the guiding factor, and thus in the present case "Pike perch" would be the natural heading. There should, of course, be appropriate cross references.

I think that the general principles of indexing with cross-references should apply in Mr. Fearing's index. Care should be taken not to make the affair too cumbersome.

MR. FEARING: With the permission of the Society I will go ahead and do the indexing the way I have started it.

DR. BEAN: I would like to say that if Mr. Fearing should index the paper mentioned under "Pike perch," and then have a subhead "Difficulties of taking eggs," he would cover the ground very satisfactorily.

SECRETARY: It would hardly be necessary to make a reference under so general a heading as "Fish culture," for this would merely make the index cumbersome rather than suggestive. It is about the last place one would look in such an index for information on pike perch eggs.

Mr. Fearing: That covers that point. Another thing of importance is in regard to reports of the Treasurer and various committees. There are 41 different Treasurer's reports, thus necessitating 41 references.

Secretary: Could not one general reference be made to suffice?

Mr. Fearing: We cannot have one reference. There is a Treasurer's report for each year of the Society's existence.

Secretary: But they would appear only in one place in the index. There would be no cross references.

Mr. Fearing: That is so. It could be simplified in that way. That was our idea if it met with the Society's approval, because otherwise it would require a great deal of space.

The next question is: Under broad subjects like "Apparatus," would you care to have the references in the order of the years in which they come, or alphabetically? That is to say, for instance, under the head "Apparatus," would the order be "Brackett's trays" and then "Ainsworth's screens"? Brackett's trays came out first and Ainsworth's screens afterward. Logically the reference to Ainsworth's screens should be first in the index.

Secretary: I think an alphabetical arrangement is by all odds the best.

Dr. H. B. Ward: It seems to me that we passed one little item without note, that in some cases may have considerable importance: I refer to the reports of committees. Reports of Nominating and Auditing Committees, etc., would be of little value if indicated under forty different headings. On the other hand, if there is a committee on international relations or a committee on best methods of handling certain matters, it might be important to get at the report of the committee. The report of the committee in such case would seem to me to have a permanent value, whereas the report of an auditing or nominating committee has very little permanent value.

Mr. Fearing: I think, perhaps, if it is satisfactory, I might pick out the important committees.

Dr. Ward: Personally I do not think any better plan could be found.

Mr. Fearing: Another question is: Shall the subject entries be followed by the name of the author? As for example, "Fish Culture—A Practical Art; by J. H. Bissell."

Dr. Ward: There is only this to say, speaking personally again, I have recalled that in a certain year Mr. Dwight Lydell said something in a paper on the bass that bore on another point, and if one had to hunt through every paper on the bass to find which one Mr. Lydell wrote, it would be hard to get at that specific information.

Mr. Fearing: You will find it under the heading "Lydell, remarks on black bass." There is really a double entry of the author's name, for it would appear both under the headings "Lydell" and "Black bass."

The next question is: Shall authors' names be entered in full, or as given in the list of members, or with initials of first names only?

There are many men who, perhaps, for the purposes of this Society use a middle name, as A. John Brown, instead of A. J. Brown. It is as simple one way as the other, to put them in as they are given in the list of members, or otherwise. In many cases it is almost impossible to give the full name correctly.

Secretary: Perhaps it would be best to have no hard and fast rule. Simply make the entry according to the author's signature.

Mr. Fearing: The simplest way would be to give the name as it appears in the list of members.

Another question is: Shall the reference be given to the year of meeting or number of meeting?

Dr. Ward: There is one point here, that we all should bear in mind, and that is that all librarians who bind these proceedings will put on the back the number of the volume and not the year, or if they put on the year they may put on the year of publication, which is the date recognized, and not the year in which the paper was read. Now that will render it difficult to refer from this index to a set of the Transactions on the shelf of any public or scientific library. If I am not mistaken, in the library indexes, like Poole's Index, reference to such societies take the volume number as contained on the title page, and not the year. Consequently our references would not agree with the standard library index references.

SECRETARY: Do they not contain both the volume number and the year?

DR. WARD: The year of publication and not the year of meeting. In the printing of scientific bibliographies I think that custom is absolute. The year of publication is the only date recognized, and not the year in which the meeting happened to be held.

MR. FEARING: You need not worry about anybody going to look up the records of this Society in any public library, for the only complete set is in the library of the Bureau of Fisheries at Washington.

DR. WARD: As a teacher I feel this side of it. Personally I shall refer to the publications of this Society, not to all of them, because we have not access to all of them.

There are certain things that are very important, and those things ought to be used more and more in our institutions where teaching along biological lines is carried on, lines that involve the work that the Society is doing. I believe the Society can gain wider influence and can exert greater power in the development of this subject if we can only get the periodicals where they can be referred to. I have cited people to publications of this Society and they have replied to me that unfortunately they cannot be found in the library. So there is a real difficulty. Nevertheless, in some libraries in the larger cities, it is possible to get a considerable number of the publications of this Society, and it ought to be possible in future to get all of them.

I think that the great libraries in our cities should have as nearly a complete series as possible. I know of two cities that have recently searched out as nearly a complete series as possible. Now, that is of importance here, because if we are to make this index useful to the public seeking information on fish matters, and to the patrons of libraries, the index must be put in the form in which an index is usually found. So I think the proposals here to follow what is the customary method of indexing are really very important for the welfare and interest of the Society.

SECRETARY: May I ask if there is to be an index of the material embraced in the discussions?

MR. FEARING: That will come in under the discussion of each paper.

PRESIDENT: Without cross references?

MR. FEARING: With cross references—for instance, if Mr. Clark and Mr. Meehan had one of their discussions on fry and fingerlings, it would be indexed "Meehan, remarks on fry," and "Clark, remarks on fingerlings." The heading, "Fry and fingerlings," would also give the references.

SECRETARY: Discussions sometimes wander over a wide variety of subjects, and it is hard to get at the meat of them.

MR. FEARING: It makes indexing very difficult. I remember in one instance where the discussion started on the pollution of water and ended up on fry and fingerlings, and it went the whole gamut between, on almost every known subject. (Laughter.)

DR. WARD: There is one other point concerning which I should like to inquire. I am not perfectly clear from what I have heard whether this index is to be printed as a separate pamphlet or in connection with the volume of Transactions.

MR. FEARING: I was going to ask about that. It seems to me if it will be of any use to the Society it would be better to have it printed as an addition to the Transactions, where it can always be found.

SECRETARY: As a part of the Transactions?

MR. FEARING: Yes, but I am open to suggestions. An index bound as a separate volume is very apt to be mislaid.

Dr. Ward: And not only that but the index if printed as a separate pamphlet may not get into the hands of the libraries that get the volumes. Then the library, which certainly needs the index as much as any individual could, would be without that essential part.

Secretary: It would make a rather voluminous affair. You will note that the little author's index which I worked up last year, where only one reference is made to each of the 433 papers published, occupied 15 pages in the report. The complete index Mr. Fearing is preparing will make quite a volume.

Mr. Fearing: But the index ought to be in the hands of every owner of the volume, and as Dr. Ward says, if published separately it is very apt to be missing.

Secretary: Undoubtedly the most desirable place for it is in the regular volume of the Transactions. By using small type and arranging the material perhaps in double columns on a page, the whole thing can be put in more compact form than I at first thought.

Mr. Fearing: I would be glad to pay a certain proportion toward doing it.

Professor Dyche: Would it not be wise to have it printed both ways, to have a certain number of Transactions and a certain number of separate copies also? It is often done. I never heard of their being lost. It is very unhandy to pull down a large volume just to get at an index.

Secretary: Reprints could be made.

Mr. Fearing: There could be a certain number of reprints that the Society could sell.

Professor Dyche: I would rather have it separate and not connected with the volume. I do not care about pulling down the largest volume in the series to get at the index. I would rather have the index by itself every time.

Dr. Ward: Have you calculated the size of the index when printed?

Mr. Fearing: It is a hard thing to estimate, as it all depends on the size of the type used. But it will probably be 115 or 120 pages or more.

Dr. Ward: In view of the very liberal offer of Mr. Fearing to assist in this matter, I should like to move that the Society undertake to carry out the printing of the index, and that the question of securing reprints of this part be left to Mr. Fearing and the Secretary, their opinion to be based on what seems to be the demand for a separate publication of that portion.

Seconded by Dr. Bean, unanimously carried and so ordered.

A paper by Mr. Thompson was then read and discussed.

Dr. Field then presented his paper.

President: I would suggest that the discussion of Dr. Field's interesting paper be deferred until tomorrow morning as the time has arrived when we agreed to visit the hatchery ponds at the park. If there are no objections we will leave the discussion until tomorrow. Before we go I would ask that you set a time for the meeting tomorrow.

Secretary: I move that we convene at 9 o'clock tomorrow morning.

Seconded by Professor Dyche, and unanimously carried.

Adjournment then taken.

Wednesday, October 4, 1911, 9.30 a.m.

Meeting called to order at the same place by the President.

The visit of the members of the Society to the Forest Park fish-cultural station was discussed.

President: We will listen to the report of the Committee on Time and Place of Meeting.

TIME AND PLACE OF NEXT MEETING

Mr. S. W. Downing, Put-in Bay, Ohio: A majority of the committee has decided on Denver as the place for the next meeting, but the time has not been fully decided on, although it will be early in September—we could not get the date.

PRESIDENT: Will you make a further report?

MR. DOWNING: Yes, we will report the date this afternoon.

PRESIDENT: You say that is a full report of the committee or just a majority report?

MR. DOWNING: It was made unanimous.

PRESIDENT: You hear the report of the Committee on Time and Place of Meeting. What action will you take?

PROFESSOR DYCHE: I move the report of the committee be accepted.

Seconded.

DR. FIELD: I have a cordial invitation for the Society to hold its meeting in Boston, with meetings also in Providence and Gloucester; but we do not want to press the matter this year. We believe there are many reasons why we should go to Denver next year but we do want to put ourselves in line for consideration the following year. We have not met in New England for a great many years, and we believe that Massachusetts, Rhode Island and Connecticut should have some consideration in this matter. We can assure you that you will receive a most cordial reception.

Now another question arises: I chance to be Secretary of the Association of Game Commissioners, and I think without doubt we can arrange to have the meeting in Denver either just before or just after the meeting of this Society, which seems desirable.

DR. WARD: There has been some doubt expressed by various people, possibly because they did not understand the situation, as to the advisability of holding the convention in Denver. I believe it would be wise to have Mr. May tell the Society what he has in the way of information regarding the Denver situation.

MR. W. L. MAY, Denver, Colo.: I did not get a chance to lay before the committee what we had in the way of invitations. It has been the custom heretofore to present these invitations from different bodies, towns and cities directly to the committee, without referring them to the meeting. But if you do not mind I would like to read extracts from invitations we have in favor of Denver.

The Denver Convention League writes:

The Denver Convention League, on behalf of the business interests of this city, extends to your organization a most cordial invitation to hold its 1912 session in Denver.

We have in this city and state many enthusiastic sportsmen and we believe that if a session of your organization were held in Denver that a considerable accession of members could be obtained. Apart from the interesting sessions of your Association your members would be delightfully entertained at the nearby fishing places which abound in this locality.

Many of your members have doubtlessly visited this state and know of its many advantages both as to climate and scenery, and it is therefore not necessary to enlarge on these points.

We will act in perfect harmony with the members of your organization located in this state in the endeavor to make your session here the most successful one ever held in your history.

A communication from the Denver Chamber of Commerce includes the following:

The Denver Chamber of Commerce desires to join with the Denver Convention League and other commercial bodies in extending to your Society a hearty and cordial invitation to come to Denver in 1912.

We believe that the entertainment Colorado can offer you is unexcelled by any other commonwealth in the Union, and nothing would give us more pleasure than to be the hosts of the members of your Society and show them the "Sportsman's True Paradise"—Colorado.

Another invitation is from the Colorado Sportsmen's Association, as follows:

At a meeting of the Colorado Sportsmen's Association held September 9, it was unanimously resolved to invite your Society to hold its next annual (1912) meeting in our city.

Colorado has well been denominated the nation's playground. It can also, with good and sufficient reason, be called the trout fisherman's paradise.

The majority of us imagine we are well equipped mentally and otherwise, to kill fish, but very few are versed in even the rudiments of fish propagation, and the addresses of your members would be of great educational value.

We will be more than pleased to extend every courtesy within our power, and trust that it may be possible to arrange as one of the features of your entertainment a visit to our new club house on the South Platte. We feel confident that the holding of your meeting in our city will not alone add materially to your membership, but greatly to our knowledge of fish culture as well.

The Hon. Robert W. Speer, Mayor of Denver, extends the following invitation:

It gives me pleasure to join in the invitation to your Association to hold your next session in Denver. The city administration will be pleased to co-operate in every manner possible with the local commercial bodies in extending your members a genuine western welcome, and every effort will be put forth to make your visit to our city agreeable and instructive.

From Governor Shafroth we have the following:

In behalf of the people of the State of Colorado I wish to extend to you an invitation to hold your next annual meeting, for 1912, in the city of Denver, in this state.

On account of Colorado being a western state, and its mountains being covered with original forests, and on account of the enforcement of the game laws of this state, we have still left considerable game in our mountains. We have here associations composed of sportsmen, many of whom are residents of the city of Denver. The Game and Fish Department of the state of Colorado has in every way attempted to preserve the game and fish and has stocked the streams with fish and placed in the forests much game.

Denver is an excellent city in which to hold a convention. The climate in summer is ideal. Within two or three hours' run, in the hottest weather, you can reach the region where perpetual snow exists, and in going you pass most superb wonders in scenery.

From Mr. James A. Shinn, State Game and Fish Commissioner, comes the following:

I want to join Governor Shafroth in giving your Society an invitation to hold its 1912 Convention in Denver. If you conclude to do so, I will say, in behalf of the people of the state of Colorado, that we will see that you get your fill of speckled trout from our sparkling streams, as well as bear, deer and grouse. You can visit some of the eight fish hatcheries that are now being operated by the state, from which we will be able to distribute some 29,000,000 of fry by the close of 1912. The Denver fish hatchery is located near the city and can be reached by automobile.

We get two hatches of spawn per year, and take the native and rainbow spawn in the late spring and early summer, while our brook trout begin spawning the first ten days in October.

We consider our game and fish and our wonderful mountain scenery as one of our best assets. Thousands of people from other portions of the Union visit our state for the purpose of hunting and fishing during the heated season at home.

Report unanimously adopted as to the place of meeting.

PRESIDENT: The next place of meeting is, by unanimous vote, the city of Denver.

In accordance with the action of the Program Committee we will take up an address by Dr. S. A. Forbes on "Definite Results of Survey Work on the Illinois River."

The address was delivered and discussed.

PRESIDENT: If there is no further discussion we will proceed with the next paper. I will call on Professor Dyche for his paper.

PROFESSOR DYCHE: This plan for a fish hatchery has some things about it that need to be discussed, though I have no pet theory to exploit. I am going to try to found a fish hatchery suitable for conditions in the state of Kansas, and I desire the members to discuss it. I want to ask questions myself, and hope to be asked questions; because if I am making any mistakes I want to know it right away. The hatchery will be built in a short time, and I want to be as straight as possible before starting in on it. As there will be considerable discussion I think it would be better to take some other paper now.

PRESIDENT: Then we will take the following paper: "The Absorption of Fats by the Alimentary Tract with Special Reference to the Function of the Pyloric Cœca in the King Salmon, *Oncorhynchus tschawytscha*," by Dr. Charles W. Greene, Department of Physiology, University of Missouri, Columbia, Mo.

The paper was then read.

PRESIDENT: We will have to leave the discussion of this interesting paper till the afternoon session. The papers read have provoked so much discussion that we are behind, and a session this evening will be necessary. The meeting will be called this afternoon on the steamer *Illinois*. Be sure to be at the wharf a few minutes before 2 o'clock. Dr. Bartlett and one or two more will be at the hotel to show the way. We will leave the hotel here at quarter of two.

Recess was taken until 2.00 p.m., to meet on the steamer *Illinois* at that time.

The President called the meeting to order at 3 o'clock p.m., same day, on board the steamer *Illinois*.

SECRETARY: The Anhaeuser-Busch Brewing Company extends a cordial invitation to us to inspect their plant at our convenience, but preferably before 4.00 p.m. It is asked that we inform them of the time selected that they may give the Society hospitable attention.

PROFESSOR DYCHE: I move that this invitation be accepted. Being from Kansas I think it is proper for me to make the motion. (Laughter.)

PRESIDENT: Will the Professor set the time?

TREASURER: I suggest that the time be from 4.00 p.m. to 8.00 a.m. (Laughter.)

The invitation was then unanimously accepted.

DR. BARTLETT: I want to say that the Anhaeuser-Busch brewery is one of the most interesting manufacturing plants in the West, and it covers the largest area of ground. I have no doubt your reception will be all that you can ask for, over and above what you want to drink.

PRESIDENT: Will you state a time so that we may notify the company when we will be there?

SECRETARY: Is it not probable that our business will be finished by 3 o'clock tomorrow afternoon?

PRESIDENT: Yes.

SECRETARY: Then I move that we go out immediately after adjournment tomorrow.

Motion seconded and unanimously carried.

SECRETARY: A communication is at hand from Mr. Charles Flegel, member of the Imperial Fisheries Society, Vienna, Austria, and a corresponding member of the American Fisheries Society. It is in relation to the sponge fishery of the Mediterranean. It is quite a long communication and possibly it would be well not to read it at the present time. It calls for action I think by the Committee on Foreign Relations or the Committee on Resolutions. With the President's consent it might be referred to the proper committee.

PRESIDENT: I would suggest that a motion be passed to refer to the Committee on Foreign Relations with power to act.

So moved by Dr. Greene.

Motion seconded, unanimously carried, and so ordered.

SECRETARY: Some years ago authority was granted to sell reports of the Society for 50 cents a copy. It occurs to me that it would be well to increase this price, inasmuch as 50 cents does not represent the cost of getting out one of the reports. Even the less pretentious offerings cost more than 50 cents a copy. I think it would be well to increase the price to one dollar a copy. I submit this as a recommendation.

Another question it would be well to consider is the time of the payment of dues by applicants for membership. Heretofore when names have been proposed for membership the money has not accompanied the request. It has not been the practice to ask for payment of dues until after the member has been elected. I think it would be well for the Society to adopt a rule requiring that the fee shall accompany the application for membership.

Another matter of importance is a proposed revision of the Constitution, particularly Article V, relating to the order of business.

PRESIDENT: I think that is in the hands of the Committee on Resolutions now. It has reference to the change in Article V as to the order of business, is not that the case?

DR. FIELD: I did not know that it had been formally referred to us.

SECRETARY: You refer to Article II, do you not?

PRESIDENT: Article II and Article V. There are omissions in Article V that necessitate some changes.

If the Committee on Nominations is ready we will receive the report this afternoon.

DR. FIELD: Has any action been taken in regard to the amount of money due Mr. Willard? He has advanced certain moneys. It is entirely unjust for the Treasurer to have to advance funds in that way.

SECRETARY: Inasmuch as the dues are now collectable for the coming year, possibly much of the deficit will be wiped out within a month at the outside, and if we inaugurate the campaign proposed for the collection of dues from our delinquent members I believe that it can be wiped out entirely.

MR. FEARING: It amounts to nearly $600.

SECRETARY: The expense for printing the next report will not come up until probably along in January or February, so that everything that is collected for the next few months can be applied on the debt. I believe we have something like $100 on hand now, that has just come in.

PRESIDENT: Do you think the amount coming in will cover the deficit?

TREASURER: No, I think not. Our Secretary refers to the amount in hand of about a hundred dollars; but there are some debts unpaid that will practically wipe that out.

SECRETARY: That is so.

TREASURER: I do not see that we can do anything more than we have done right along. I have not asked for any action to be taken in this matter. The most I might ask for perhaps would be a vote authorizing the Treasurer from time to time, as he may deem necessary, to hire such money as may be required to carry on the work of the Society. I have not found any fault, and if I am re-elected to office, I will do my best to gather in all the funds possible. I do not think I shall find any fault in the matter. But I do think that perhaps a vote authorizing the Treasurer to hire such sums of money as may be necessary might be in order.

MR. GEORGE H. GRAHAM, Springfield, Mass.: I would like to ask how many members there are in the organization?

SECRETARY: About 625.

MR. GRAHAM: It seems to me that an organization of this kind, doing the work we are doing, ought to have ten times as many members as we have. If people generally knew, if our sportsmen knew, what this Society is doing, I think we could get a thousand members tomorrow, and then we would not have any deficit. Let us increase the membership.

TREASURER: That really is the keynote of the whole situation. We can get along nicely with the present dues if we can only increase the membership to a thousand. We have now about 600 members and it would not be difficult if everyone would put his shoulder to the wheel. There should be no great trouble getting a thousand members in a Society like ours.

SECRETARY: A year ago a campaign was inaugurated to secure new members. At the office of the Bureau in Washington we had access to the names of many fish and game clubs in the country, and we sent out hundreds of circulars. As a result of that campaign something like a hundred new members were secured. It is surprising to know what little attention is paid to anything of the sort. However, I trust that Mr. Graham can suggest some plan of action to increase the membership.

MR. GRAHAM: Sending out letters is all right, but nine out of ten people throw them in the waste basket. The best way to do it is for each member to procure a number of new members. Every man here could, if he tried, secure 10 members before the next meeting. I believe that I can secure 25 myself. But it must be done by personal work. You must go to the men. They do not know what the dues are; talk to them three or four minutes and they will find out about the Society and will be glad to join. We will not have any trouble in getting a thousand members.

Look at the sportsmen in Missouri. I understand they have an organization here now of a thousand members, and there ought not to be any trouble in getting a hundred of those members to join this Society. There is not an organization in the country doing the grand work that this Society is doing; and certainly the sportsmen and the sporting goods manufacturers should help out; manufacturers of fishing tackle and implements should assist. We ought not to be in need of funds; we ought to have ten times as much money as we require.

Mr. Fearing: We need more publicity.

Treasurer: Is there any objection to the general public attending the meetings?

President: No.

Treasurer: Then it seems to me that it would be a good idea for our Society, through its President or Chairman of the Executive Committee, or Secretary, to send out personal invitations to the members of the sporting clubs, boards of trade, etc., to attend our meetings. I have an idea that a great many members of sporting clubs would gladly attend meetings if they knew they would be welcome. If invitations are sent to these clubs a much larger attendance will be secured, and thus we will get new members.

Mr. E. T. Grether, St. Louis, Mo.: I would say that until a week ago I did not know anything about the meeting, and I would suggest that it would be advisable for the Society to have a committee on publicity, so that they would be able to send out advance notice of the time and place of meeting as well as something of general interest with regard to the meeting. I know it to be a fact that there is no state in the union but that has one or more sportsmen's associations; and the officers of those associations would be very glad without doubt to arrange something to interest the public, especially the clubs. In the city of St. Louis we have 185 clubs, and I would have sent some word to them of the meeting here, but I did not know anything about it until a short time ago when I made application for membership in the Society. I did not know where the meeting was to be held, and I merely put in the paper seven or eight lines mentioning that there would be a meeting on October 3. Mr.

Geserich, President of the Fish Commission, was out of the city and I could not secure any information from him. I would have gladly written more and the people would have been glad to read it. There are things that come up in the meetings that are of great importance; and I know the sportsmen of this city would have turned out gladly if they had known of it.

PRESIDENT: The question of a committee on publicity is important, and as further talk only consumes time and it is evident that this is the solution of the problem, I suggest that somebody make a motion that this matter be referred to the Committee on Resolutions with instructions to report recommending the creation of a Committee on Publicity, so we can dispose of the matter at once.

DR. FIELD: It seems to me it would be well to act in full meeting. It does not seem to me the function of the Committee on Resolutions to report on matters of general business.

PRESIDENT: I think we can dispose of it now.

MR. GRAHAM: Would it be better to do that or to add to the Committee on Membership and have the same committee act as both?

PRESIDENT: There is no Committee on Membership.

MR. GRAHAM: I think there ought to be.

PRESIDENT: It is understood that the whole Society is really a Committee on Membership.

MR. GRAHAM: I move that the President appoint a standing committee of three on publicity.

Motion seconded and unanimously carried.

ELECTION OF OFFICERS

PRESIDENT: We will hear from the Committee on Nominations.

DR. BEAN: The Committee on Nominations offers a unanimous report of names for officers and committees for the ensuing year. In making these nominations we have been guided by the rules which have governed the

Society heretofore, that is to say, the Vice-President is the candidate for the presidency, and the chairman of the Executive Committee becomes the candidate for the vice-presidency. All matters have been considered carefully by the committee and the names are offered now for your ratification.

President: S. F. Fullerton, St. Paul.

Vice-President: Charles H. Townsend, New York.

Vice-Presidents of Divisions:

Fish Culture: John W. Titcomb, Lyndonville, Vt.

Aquatic Biology and Physics: Dr. Edwin Linton, Washington, Pa.

Commercial Fishing: A. B. Alexander, Washington, D. C.

Angling: H. Wheeler Perce, Chicago, Ill.

Protection and Legislation: Dr. T. S. Palmer, Washington, D. C.

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

Corresponding Secretary: Dr. H. M. Smith, Washington, D. C.

Recording Secretary: Ward T. Bower, Washington, D. C.

Assistant Recording Secretary: Miss Ethel M. Smith, Washington, D. C.

Executive Committee: Dr. Henry B. Ward, Chairman, Urbana, Ill.; Daniel B. Fearing, Newport, R. I.; E. Hart Geer, Hadlyme, Conn.; D. H. Power, Suttons Bay, Mich.; A. R. Whitaker, Phœnixville, Pa.; R. Tyson White, Brooklyn, N. Y.; W. L. May, Denver, Colo.

Committee on Foreign Relations: Dr. H. M. Smith, Chairman, Washington, D. C.; E. N. Carter, St. Johnsbury, Vt.; Dr. George W. Field, Boston, Mass.; Dr. F. M. Johnson, Boston, Mass.; H. F. DePuy, New York; Dr. J. A. Henshall, Tupelo, Miss.

Acting upon the authority and with the consent of the committee I move the election of these officers and members of committees.

Motion seconded and unanimously carried.

The report was adopted and the persons recommended by the committee were declared elected as the officers of the Society for the ensuing year.

PRESIDENT: We will proceed to the discussion of Dr. Green's paper.

Dr. Green's paper was then discussed.

PRESIDENT: The next paper is by Mr. W. O. Buck, on "Control in Pond Culture."

The paper was read and discussed.

PRESIDENT: Before we take up the next paper I will announce the Committee on Publicity. I have taken advantage of the elementary prerogative of a chairman and have appointed myself as chairman of that committee.

As the other members of the committee I will appoint Mr. W. L. May, of Denver, and Mr. Ward T. Bower, of Washington, D. C.

PROFESSOR DYCHE: I move that when we adjourn we meet at our regular place at the Planters' Hotel at 8 o'clock this evening.

Motion seconded and unanimously carried.

PRESIDENT: The next paper is by Dr. H. B. Ward and is entitled, "The Distribution and Frequency of Animal Parasites, and Parasitic Diseases in American Fresh Water Fish."

The paper was read and discussed.

MR. BUCK: I would like to offer one suggestion, in connection with the Publicity Committee, before a motion to adjourn is made. I feel sure that when we have a good thing we cannot have too much of it, and without meaning in any way to reflect upon the very efficient committee that has been appointed, I wish to suggest that each one of us should feel it his duty to assist in every way he can toward the publicity of the cause and toward the procuring of new members. I want also to ask permission to add my friend here who suggested the committee, and talked upon it in a way which indicates that he will have a great deal of enthusiasm for the cause, and will be able to help it along. With your permission I move that Mr. Graham be added to the committee.

PRESIDENT: That is a very good suggestion.

The motion is that the committee be enlarged by the addition of Mr. Graham.

Motion seconded and unanimously carried.

PRESIDENT: Mr. Graham is added to the committee.

A recess was here taken until 8.00 p.m., at the Planters' Hotel.

The President called the meeting to order at the Planters' Hotel, St. Louis, at 8.15 p.m.

PRESIDENT: Gentlemen, Mr. L. A. Geserich, President of the Missouri Fish Commission, wants to say a few words to you in the way of extending an invitation.

MR. GESERICH: Mr. Chairman and gentlemen of the American Fisheries Society: I was saying to Mr. Bower a few moments ago, that I did not want to interfere with any prearranged plan that you gentlemen may have; but I do want to say this, that the State Fish Commission of Missouri recently secured a new distributing car, one equipped with every modern device for handling fish and water. I thought if you would like to profit by our experience and see what we have, we should be glad to have you visit the car tomorrow. I really think we have something that no other state has today, or even the Bureau of Fisheries at Washington, D. C., in the way of a fish distributing car—that is, so far as the water and air plans are concerned. If you can come out tomorrow afternoon we shall be highly pleased. It will take about 20 minutes to run out there. I shall be very glad to have you look the car over if you can.

PRESIDENT: What time will the car be on view?

MR. GESERICH: It is in storage at Compton Avenue yards. I will have the superintendent arrange to fill a number of the big tanks with water and obtain a supply of air. We can then make a demonstration, I think, that will be of interest to all of you gentlemen. If 2 o'clock would be convenient tomorrow we could run out from here and not interfere with any plans you may have after that in the way of entertainment. I understand you are going to a place where they make a product in Missouri called beer. (Laughter.)

PRESIDENT: We had heard they did something of that sort in Missouri, and some of our members being of an investigating turn of mind wanted to ascertain just what it was, as they understood that the Missourians thought a great deal of the product. (Laughter.)

MR. GESERICH: I will say that I have gone down there frequently. You know I have a little fun once in a while as I go. I must get that fun myself, and if I don't grab it I lose. We make a few fish here and also have the biggest brewery in the world. When you get down there the brewery is yours, as far as your capacity is concerned while you are there. (Applause and laughter.)

PRESIDENT: I suppose, gentlemen, that if we push things lively we can finish by half past 12, and after luncheon we could visit the car and from there take up this other investigation. I think we will try and fix that as part of the program.

MR. GESERICH: I shall be glad to be here at 2 o'clock and will escort you to the fish car, and from there to the brewery. It will take 25 minutes to run from the fish car to the brewery.

PRESIDENT: We will be ready perhaps a little before 2 o'clock.

MR. GESERICH: Then I will be here before 2 o'clock.

PRESIDENT: Is the Auditing Committee ready to report?

SECRETARY: The chairman of the Auditing Committee handed the report to me. It is as follows:

St. Louis, Mo., October 4th.

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

Signed: S. P. Bartlett, H. Wheeler Perce, W. T. Thompson } *Auditing Committee*

Report unanimously accepted and adopted.

TIME AND PLACE OF NEXT MEETING

President: I will call on the Committee on Time and Place of Meeting for its final report.

Mr. Downing: We have decided that the time should be early in September, and as the first Tuesday comes on the 3d, the committee thought that this would be the most convenient time.

President: You hear the report of the Committee on Time and Place of Meeting. What is your pleasure in the matter? The full report as presented is, that the next meeting shall be held in Denver, Colo., beginning Tuesday, September 3, 1912.

Motion made and seconded that the report of Committee on Time and Place of Meeting be adopted as finally given.

Motion unanimously carried and so ordered.

President: We will now listen to a paper by Prof. L. L. Dyche, entitled "A New and Enlarged Fish Hatchery for the State of Kansas."

Professor Dyche then read his paper which was discussed.

Dr. S. P. Bartlett presented a paper on "The Decrease of the Coarse Fish, and Some of its Causes." The paper was discussed.

Adjourned to 9.00 a.m. next day.

Thursday, October 5, 1911, 9.55 a.m.

Meeting called to order at the same place by the President.

PRESIDENT: We will now listen to a paper by Mr. S. G. Worth, of Mammoth Spring, Ark., on "Fresh Water Angling Grounds for the Striped Bass."

The paper was read and discussed.

PRESIDENT: The next paper is by Mr. S. W. Downing: "Are the Hatcheries on the Great Lakes a Benefit to the Commercial Fisherman?"

Dr. Ward then read the paper by request.

Before reading the paper Dr. Ward said:

I am very glad to be of any service to my friend, Mr. Downing, especially because the paper was of considerable interest to me as I read it over at his request. Please understand that all this is to be attributed to him. I know he deserves it.

After being read the paper was discussed.

PRESIDENT: That embraces all the papers to be read by those present, and we will now take up Dr. Charles H. Townsend's paper on "The Pribilof Fur Seal Herd, and the Prospects for its Increase."

The paper was read and discussed.

Mr. Worth then read a paper, by Mr. J. F. Boepple, entitled, "Notes on the Fish of the Cumberland River."

PRESIDENT: The next paper will be, "Some Observations on the Culture of Yellow Perch in Ponds," by Mr. W. B. Gorham, of Erwin, Tenn.

The paper was then read.

PRESIDENT: The next paper will be, "Atlantic Salmon in Fresh Water," by Mr. Charles G. Atkins, of East Orland, Me.

The paper was then read by Mr. Thompson.

PRESIDENT: The next paper will be, "Notes on Some Seldom Marketed Salt Water Fishes," by Mr. John Treadwell Nichols, of New York City.

I will ask that it be read by Dr. Bean.

The paper was then read and discussed.

PRESIDENT: The next paper is one that I think I will have to ask our friend, Dr. Bartlett, to read, otherwise he might feel hurt. The title is, "As to the Carp," by Mr. W. T. Hunt, Secretary of the Chester County Fish and Game Protective Association, West Chester, Pa.

Dr. Bartlett: I will ask to be excused.

President: Then I will give it to the next best friend of the carp, Professor Dyche.

Professor Dyche then read the paper referred to, after which it was discussed.

President: The next paper is on the subject of "The Taxation of Oyster Properties," by Mr. Henry C. Rowe, President of the New York and New England Oyster Shippers' Association, Groton, Conn.

I will ask Mr. Buck to read this paper.

Mr. Buck then read the paper.

President: I will ask Mr. Bower to read the next paper which is on the subject of "Notes on Pond Culture in the Philippines," by Mr. Lewis Radcliffe, Washington, D. C.

Secretary Bower, before reading the paper, said: Mr. Radcliffe is one of the assistants in the Bureau of Fisheries and is well qualified to write on this subject. While attached to the *Albatross* in the capacity of Assistant Naturalist he made an extended cruise through the Philippine Islands.

PAPERS READ BY TITLE

President: The Secretary is requested to read the remaining papers by title, with a view to their publication in the Transactions.

Secretary: The following papers presented have not been read:

"Trematode Parasites in the Skin and Flesh of Fish and the Agency of Birds in their Occurrence," by Dr. Edward Linton, Washington, Pa.

"Notes on Pond Culture at San Marcos, Texas," by John L. Leary, San Marcos, Texas.

"Future of our Brook Trout," by S. F. Fullerton, St. Paul, Minn.

"Some Observations on Rearing Sunfish," by J. J. Stranahan, U. S. Bureau of Fisheries, Bullochville, Ga.

"Licenses for Hook and Line Fishing," by Dr. T. S. Palmer, U. S. Biological Survey, Washington, D. C.

"Regarding Fishways and Dams," by Prof. L. L. Dyche.

"Experiments in Rearing Bass from No. 1 to No. 2 Fingerlings at the Mill Creek Station in Michigan," by Dwight Lydell, Comstock Park, Mich.

Mr. Buck: I move that the papers read by title by the Secretary be included in the printed report.

Motion seconded and unanimously carried.

President: We have had presented 22 papers; I think that the Society can congratulate itself on the high character of these papers. Nearly every one of them has been of very great interest and productive of discussions of great value to all.

We will now listen to the report of the Committee on Resolutions.

REPORT OF THE COMMITTEE ON RESOLUTIONS

The report was presented by Dr. Field.

Dr. Field: The Committee on Resolutions unanimously recommends the adoption of the following resolutions:

Resolved, That this Society extends to His Honor, the Mayor of St. Louis, to the Honorable Commissioners of the states of Missouri and Illinois, and to their deputies and superintendents thanks for their hospitality and considerate attention to the Society and its members.

Resolved, That a vote of thanks and of appreciation be extended to our Secretary, Mr. Ward T. Bower, for his exceeding efficiency and courtesy in the performance of the duties placed upon him.

Resolved, That the thanks of this Society be extended to the management of the Planters' Hotel and to the press in St. Louis for the uniform courtesy and for the many favors extended to our members.

Resolved, That the Society records with sincere regret that death has claimed ten of our members during the past year:

Moses H. Cone, Greensboro, N. C.
Frank N. Clark, Northville, Mich.
Howard M. Buller, Bellefonte, Pa.

H. D. Chichester, Washington, D. C.
William Cutler, Comstock Park, Mich.
F. C. Zacharie, New Orleans, La.
J. W. Brackett, Auburn, Me.
E. A. Jaggard, St. Paul, Minn.
Arthur Sykes, Madison, Wis.
Edward Birbeck, London, England.

To the families and friends of the deceased members we hereby extend our deepest sympathy, and we request the Secretary to spread this resolution upon our records and transmit a copy to the respective families.

WHEREAS, in the sudden passing of Frank N. Clark, this Society has lost a member who, by industry, by intelligent enthusiasm, by honesty of purpose and essential integrity of character, has done much directly and indirectly to advance the cause of fish culture; and who, by his singleness of purpose, by his energy in surmounting obstacles, by consistent and insistent forcefulness of mind and body, patiently worked his way to the forefront in the ranks of fish culturists, and who, by helping others, unconsciously helped himself, and, above all, advanced the cause which he so ably represented, be it

Resolved, That while recognizing the beneficence of the Divine Will, we deeply deplore the loss which we have sustained; and further, that we appreciate sincerely the indescribable impress for good which the Society received through the presence of our late member and President; and be it further

Resolved, That a copy of these resolutions be transmitted to the family, to whom we extend our deepest sympathy.

Resolved, That this Society expresses its confidence in the importance of the work of the National Bureau of Fisheries, and respectfully urges upon Congress and upon the Honorable, the Secretary of the Department of Commerce and Labor, to furnish increased facilities for prosecuting the work of developing the productive capacities of our fresh and salt waters, in order that said waters may be operated as successfully, and yield annual crops of marine food comparable to the staple products of the farm. It has been amply demonstrated that under proper laws of tenure, freedom from pollution and adequate national and state protection, our inland sea and shore fisheries can be one of the nation's most important sources of food and wealth.

WHEREAS, That since fish and shellfish, which are of great value as human food if placed in the hands of the ultimate consumer in good condition, are subject to rapid postmortem chemical changes; and

WHEREAS, Much unnecessary uncertainty relative to the condition and previous treatment checks the sale of such food, resulting in waste to dealers and to consumers; and

WHEREAS, This Society deplores the lack of accurate and scientific data relative to chemical changes and the conditions under which they occur, as is necessary to properly safeguard the interests of fishermen, dealers, distributors, consumers and the public health; be it

Resolved, That this Society urges upon Congress, upon the Bureau of Fisheries, upon the various states, and upon all competent individuals to enter upon an organized, unbiased, detailed investigation of the problems connected with the chemical composition of the various fish foods, the progressive chemical changes, and the toxic properties at various stages of decomposition together with specific applications of these facts to storage, distribution and sanitary utilization of these animals as human food.

Whereas, It has been found necessary for the successful maintenance of wild birds to set aside national and state reservations as breeding places, and

Whereas, Competent biological observation in European countries, and more recently in Illinois, Indiana, New York, California and Massachusetts, has demonstrated that in order to maintain an adequate population of fish in our streams and coastal waters, suitable and extensive natural breeding grounds must be maintained by national, state and individual initiative and action; therefore, be it

Resolved, That we urge the various states and Congress to take immediate action to acquire and to conserve such natural breeding grounds for fish, and to take appropriate measures for increasing the capacity of such breeding grounds.

Whereas, In spite of the fact that many organizations of nationwide influence have repeatedly urged attention to the enormous damage to public health and property by unnecessary and unwise methods of disposal of sewage and manufacturing wastes; and

Whereas, Many state legislatures have enacted wise laws for investigating these conditions and for conserving the public health and the public resources thus imperiled, for preventing the wholesale destruction of fish life, the restriction of areas naturally suitable for breeding places, and the ultimate ruin of the potential capacity of these waters for producing food for fish and fish for food; and

Whereas, It is notorious that in many sections of the United States the facile introduction of sewage and manufacturing waste into streams and coastal waters has hitherto checked the development of advanced methods for economic utilization of these waters; be it

Resolved, That this Society urges upon Congress, upon the legislative and executive departments of every state, and upon all good citizens, to thoughtfully act for checking the incalculably enormous wastes of nitrogenous material and of water, which, properly treated and distributed, would be more valuable upon farming land, and of many waste products of manufacturing which could at present or in the future be made of economic value.

Whereas, This Society deplores the large and increasing destruction of valuable food and game fish in the ditches of irrigation systems, and

WHEREAS, The recent and future great increase in the irrigation projects of our nation makes it a certainty that this loss will be greatly augmented thereby; be it

Resolved, That we urge upon the attention of state officials and legislative bodies in the regions where irrigation is practiced that they spread knowledge of the means by which such losses may be minimized or averted, and provide by statute for the introduction of such apparatus at the intake of ditches and canals, that the descent of fish into these artificial channels may be prevented. We deem this of great importance, not only that the sums devoted by the states and nation to the propagation and culture of fish should bring their adequate returns, but also that so attractive a feature of outdoor recreation and sport and so valuable a food material may be conserved to the people for its proper use; and further be it

Resolved, That the Society hereby instructs its Secretary to send a copy of this resolution to the Governor and to the Game and Fish Commissioners of the various states interested, and recommends this matter to be given due prominence in their next message or report.

WHEREAS, There is a difference of opinion relative to the methods most suitable for the conservation of the fur seal herd on the seal islands of Alaska, be it

Resolved, That we commend and approve the course of the Department of Commerce and Labor in its administration of the fur seal service, and we urge careful and continued study by competent naturalists of the Bureau of Fisheries, as to the habits of the fur seal and the conditions on these seal islands; and further, we definitely oppose the passage of House Resolution 277 as introduced into the first session of the 62d Congress.

Upon motion duly made, seconded and unanimously carried these resolutions were adopted.

DR. FIELD: The committee unanimously recommends the adoption of the following:

That the Secretary be empowered to sell at $1 each the volumes of the proceedings, except the last anniversary volume, which shall be priced at $2 per copy. It is further recommended that any library be allowed to purchase a complete series of volumes on hand at a discount of 25 per cent; also that volumes of which only a few copies are still on hand be not sold separately.

Upon motion duly made, seconded and unanimously carried, the recommendation of the committee was adopted.

MR. THOMPSON: Mention is made of copies not being sold separately. Now in case some member is short a few copies would it not be rather unwise to compel him to buy a complete series?

DR. FIELD: This is to outsiders. Members already have that right.

PRESIDENT: A provision was embodied in the minutes a few years ago that members should always have the right to purchase.

CONSTITUTIONAL AMENDMENT

DR. FIELD: The committee unanimously recommends that Article V of the Constitution be amended to read as follows:

ARTICLE V

ORDER OF BUSINESS

1. Call to order by President.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
    a. President.
    b. Secretary.
    c. Treasurer.
    d. Vice-Presidents of divisions.
    e. Standing committees.
5. Committees appointed by the President.
    a. Committee of five on nomination of officers for ensuing year.
    b. Committee of three on time and place of next meeting.
    c. Auditing committee of three.
    d. Committee of three on program.
    e. Committee of three on publication.
    f. Committee of three on publicity.
6. Reading of papers and discussion of same.
7. Miscellaneous business.
8. Adjournment.

DR. BEAN: I move that Article V be amended as recommended by the committee.

The motion was seconded and unanimously carried by the vote of 17 members present.

PRESIDENT: The amendment is adopted.

Mr. Graham: I want to say a word in appreciation of the work done by the Secretary. I doubt whether many members realize what the Secretary has to do, for I know a great part of the work is left for him. Now with the membership we already have and expect to have during the next year there will be an immense amount of work to be performed, and the Secretary should be aided as much as possible by the members. I think that every member whether present or otherwise should help do the work. If this Society is going to be enlarged and do any effective work it will take a good many people to do it, and a lot of people taking hold of a thing can make a grand success of it. If it is all left to one, two or three, it will not be a success no matter how able the officers are. I believe there is not a man here but would be willing to pledge himself to secure ten new members before the next meeting. It would not take much time. Each one knows the people who are thoroughly interested in the work and who are willing to take hold of it. I believe that everyone should either go to the Secretary or write to him for ten applications for membership. I understand there are to be some new blanks printed soon, a little different from the present forms. Everyone here should agree to take ten of these applications, and the rest of the members should be communicated with to see if they will not do the same.

You can see then it is only a little work for each one, and that wonderful results will be accomplished during the next twelve months. I want to urge everyone here to take some of this work off the Secretary; and if they have any new ideas that they think are going to benefit the organization to write a note to the Secretary embodying those ideas. They do not necessarily need to be adopted, but some of the suggestions will be good and can be acted upon. We need the advice of everybody, and we cannot do too much to help the Secretary carry out the work.

If it is possible to have the reports printed earlier, even if some additional money is required, I should be in favor of having it done. It would be fine if the report of this meeting could be issued in the next ninety days. We are all anxious to take home and read these papers carefully. There is a great deal of meat in them, and if we wait ten or twelve months it seems like a long way off. So if there is any manner whereby the Secretary can have this work done more quickly with additional help, I think the Society should give him that help.

Dr. Bartlett: I agree fully with the gentleman who has just spoken, and I will say further that I will pledge ten members even if I have to pay for them myself.

Secretary: The remarks of Mr. Graham have been of great interest to me, and I want to express my appreciation of his considerate attention. The work of the Secretary is rather arduous at times, and any suggestions or help will be welcome upon all occasions. This summer the work was rather light for me as I was in Alaska four months. During that time Miss Smith, our Assistant Secretary, looked after the work of the Society in excellent fashion. I want to emphasize the fact that the position of Assistant Secretary is by no means ornamental.

It occurs to me that it will hardly be necessary, as intimated by Mr. Graham, to incur much additional expense in getting the report out sooner. Of course once in a while there may be a little outlay for clerical help if it is necessary, in the judgment of the Society, to rush the report out as soon as possible. In the present depressed condition of our finances it cannot be done very well this year. However, I will try to get the report out as quickly as possible. A frequent cause of delay in issuing the report is the failure of members to make prompt returns of proof sent for their inspection and revision. Occasionally it is necessary to write two or three times before getting a response. Also, if we exercise caution and care in getting out the report it takes a little more time than if we let things slip through. My policy is to have everything absolutely accurate if possible. For example, if there is any doubt as to the spelling of a name in the membership list it is my plan to write and ascertain the correct spelling. The same idea is carried out with respect to every part of the report. Perhaps I have been going too much into detail in the matter. Any suggestions that may be made by the members in connection with getting out the report will be most welcome.

Mr. Graham: I do not believe the Secretary is going too much into detail. I think the report issued last year is the most magnificent one I ever saw, and I know it is appreciated not only by the members but by the public at large. Time is required to get out such a report, but I thought that possibly with additional help it might be done more quickly and put into circulation so that the people in general could know about it sooner.

President: I want to add a word with regard to the work performed by the Assistant Secretary, Miss Ethel M. Smith. I have had occasion to carry on quite a heavy correspondence with the Secretary's office, which, in Mr. Bower's absence, occurred between Miss Smith and myself. I know, therefore, something of the amount of work that she has done in collaboration with Mr. Bower. Her work has been fine and should be mentioned and praised and generally appreciated. There are few Assistant Secretaries that would work as cheerfully and to the extent that she did. I say this without any detraction whatever from Mr. Bower's work.

Dr. Bean: The Society has one handicap which should be overcome in some way, and that is the raising of funds in the intervals between meetings. We receive a certain amount of cash at the annual meeting, but between the annual meetings there is very little revenue except from sales of publications. This handicaps the Society in getting out its Transactions. If we could elect members by some other means than by vote at the annual meeting, we could certainly increase our funds and be able to get out the report much earlier.

PRESIDENT: That is a good suggestion. Very often in many organizations the executive committee is given authority to elect members subject to final approval by the organization at the annual meeting. I believe it would be good policy for this Society to do likewise. It will not be necessary to amend the Constitution, as the matter can be taken care of simply in the form of a motion.

SECRETARY: It is the plan from henceforth to require that all applications for membership shall be accompanied by the fee of $2.00. We can make use of this money several months perhaps before a person's name actually comes before the meeting for election. In the event of failure of election it can be refunded. The plan that Mr. Willard and I have been talking over of soliciting funds ought to be of material assistance in wiping out the deficit which now confronts us. I believe that with the two or three schemes we have in view, this deficit can be practically wiped out before another meeting. Our plans together with the excellent suggestions of Mr. Graham in the matter of soliciting new members will, I believe, assure success in the undertaking.

DR. BEAN: Then if we can provide for the election of members without waiting for the annual meeting it will solve the problem. I move that the Executive Committee have the power to accept members subject to the approval of the Society at its annual meeting.

Seconded.

PRESIDENT: The motion is in effect that between meetings the Executive Committee shall have the power to receive members subject to the approval of the Society at its annual meeting.

Motion unanimously carried.

MR. THOMPSON: In view of the words of commendation unanimously approved by the Society, regarding the efficiency of the work of the Assistant Secretary, and in order that we may express our appreciation in more tangible form, with the consent of the chairman of the Committee on Resolutions, I move that a vote of thanks and of appreciation be extended to our Assistant Secretary, Miss Ethel M. Smith, for the exceeding efficiency and courtesy shown by her in the performance of the arduous duties imposed upon her.

Motion seconded and unanimously carried.

PRESIDENT: Before we adjourn I would like to say one word. Last year we created offices known as the Vice-Presidents of Divisions. I fear that some of the members do not fully appreciate just what this means, and I would suggest, therefore, that during the coming year, when any of the members come upon matter that would be of interest to any one of the divisions it be communicated in substance to the Vice-President so that he can make his report intelligently at the annual meeing, covering thoroughly the particular subject he has in charge. This year no reports were presented, but the plan I have suggested should be the precursor of the sectional work at our annual meetings which will become more necessary as our membership increases. It is therefore to the interest of the Society for every member to be on the alert for suitable material for each of the five divisions. Anyone who has any matter with reference to angling ought to send it to the Vice-President of the section on angling, and so on with the other sections. Thus the material can be condensed and presented to the Society in concise and proper shape.

If there is no other business a motion to adjourn will be in order.

DR. BEAN: I move that we adjourn sine die.

Motion seconded and unanimously carried.

Adjourned sine die.

In Memoriam

J. F. BOEPPLE

EDWARD BIRBECK

J. W. BRACKETT

HOWARD M. BULLER

H. D. CHICHESTER

FRANK N. CLARK

MOSES H. CONE

WILLIAM CUTLER

JOHN F. HILL

E. A. JAGGARD

J. L. LEARY

ARTHUR SYKES

F. C. ZACHARIE

PART II

PAPERS AND DISCUSSIONS

GOITRE AMONG TROUT, AND EFFORTS TO ERADICATE IT

By W. E. Meehan

About the middle of February, 1908, the advanced trout fry in the hatchery at Spruce Creek, Pa., began to exhibit signs of uneasiness. Their movements were erratic and they took food languidly. The troughs were heavily laden with fish, with a flow of about three gallons of water a minute through each. In a few days it was evident that all the young trout, numbering about 2,000,000, were seriously sick, for they began to die in large numbers.

An examination showed the throat to be inflamed, and this was seemingly the immediate cause of death. At the time the disease was not considered necessarily fatal, because on transferring several thousand affected fish to outside ponds, the inflammation disappeared and most of them apparently recovered. Belief that the disease was not malignant was strengthened when it developed that advanced fry transferred to streams were later reported to have done well. There was also an almost immediate decrease in trouble after the troughs had been thinned. The cause of the disease was therefore thought to be overcrowding.

In the month of March following, when the trout had reached the size of no. 1 fingerlings, the disease appeared again, although not in as severe a form. There were less fish in each trough, but the same quantity of water was running through the troughs. On increasing the water supply by about half a gallon a minute, there quickly followed an improvement in the condition of the trout. Under the same conditions there was no recurrence, either in 1910 or 1911, in the hatching house.

Late in the fall of 1909, fungus suddenly developed among the two and three year old trout in the ponds, and it quickly spread among the yearlings. At least 20,000 fish died. The appearance of the fungus was so sudden and the death rate so large, that it was thought best to draw the attention of the U. S. Bureau of Fisheries to the matter.

Mr. M. C. Marsh, the pathologist, arrived in a few days and after an examination declared the trout to be suffering from severe goitre, of a nature which an investigator in New York State had declared to be cancerous.

For many months prior to this, Dr. David Marine, of the Western Reserve University, Cleveland, Ohio, had been studying the character of goitre among trout under cultivation in Pennsylvania, with results which seemed clearly to indicate that goitre is not the first stage of cancer and further that cancer might not naturally be looked for to follow an attack of goitre. Under the circumstances, serious as was the situation at Spruce Creek, the diagnosis of Mr. Marsh did not cause the consternation it might otherwise have caused.

A few weeks after the visit of Mr. Marsh, Dr. Marine made an examination of the trout and confirmed the declaration of the former that the fish were suffering from enlarged thyroid. At least ninety per cent of the fish either had inflamed throats or fully developed tumorous-like swelling. The death rate was as heavy among the fish having only the first stage of the disease as among those in which it was fully developed.

Until then, there was no suspicion of any connection between the so called sore throat among the advanced fry in the hatching troughs and the fungused goitrous trout in the ponds; but the connection was quickly established. An examination of advanced fry in the hatching house showed that the inflamed throat was in reality the first stage of goitre.

Dr. Marine during his investigations proved clearly, what some of the superintendents and I had long believed, that the disease was developed by accumulated filth in the ponds. He also found that goitre followed overfeeding with unnatural foods, overcrowding, and an insufficient water supply.

One year the hatching troughs were much overcrowded, the next there was an insufficient supply of water. The outside ponds were all clean and there was undisputedly a sufficient volume of water. The fish had, however, been overfed during the necessary absence of the superintendent, with the exception of a few short visits, from June until the first week in November.

That overfeeding was the principal cause was indicated by a curious but convincing condition. Beginning with number one pond, by the time number four was reached the supply of cut lungs and liver began to run short, and the fish in that pond therefore received not quite as much as those above. The same thing happened to the fish in number nine pond and number thirteen, and so on to the end. While there was some goitre in number four and the others in which the trout had been put on short rations, it was of small extent and there was less fungus and death.

Dr. Marine's investigations and the experiments of the superintendent at the Spruce Creek hatchery pointed out the remedy, and it was applied. A greater volume of water was run through the hatching troughs, the trout in the ponds were given several heavy salt baths, and the amount of food considerably lessened. Although the ponds were not believed to be overcrowded, the number of fish in each was lessened, and while cleanliness of ponds was the usual order of things, attention in this respect was redoubled.

It was not long before the trout began to show a decided improvement. Within a few months inflammation of the throat sank from ninety to less than fifty per cent, and by autumn it was hard to find a case of incipient goitre in the ponds. Old fish having the fully developed swellings of course still retained them, but to all appearances they were perfectly well.

There was not any "sore throat" among the young fish in the troughs last spring, and I never saw a healthier looking lot of trout in any fish hatchery.

DISCUSSION

PROF. L. L. DYCHE, Pratt, Kan.: What part of the throat did the soreness affect?

MR. MEEHAN: Right under the throat, just where the tongue rests; at the base of the tongue is where the inflammation first appears. It is of a pinkish color, an unnatural pink, that becomes deeper as time goes on, and then appears the swelling of the thyroid in cone-shaped lumps, sometimes found in the gills, and found at the point of the throat in quite a large number of instances.

PROFESSOR DYCHE: Does it break out—is there any raw place?

MR. MEEHAN: No, it is not raw; it is just like the tumor you see in the throat on the neck of a human being, excepting, of course, it is much smaller; it is essentially the same thing, apparently.

PROFESSOR DYCHE: Do you say that this leads to cancer?

MR. MEEHAN: I did not say that. I said that somebody else said so. On the contrary, the investigations that we made did not bear out the theory that goitre is the first stage of cancer or that cancer necessarily developed from it. Our investigations showed the reverse of that contention. But that it could develop into cancer and sometimes might so develop, was also apparent; but then it was just as a bruise that might develop into cancer. Because a fish had goitre it did not necessarily mean that the disease would develop into cancer.

The investigations were on these lines, that when a trout having a severe case of goitre was taken from the ponds and placed in a stream or water under different conditions, the disease apparently disappeared. To all intents and purposes the fish fully recovered its health. If that same fish were put back again in the pond from which it was first taken the goitre would reappear. Now, I am not a pathologist and I must therefore take the utterances of people who are. I have been given to understand that cancer is invariably progressive; it does not rise and become severe and then practically disappear, and then again become severe. But that is just what happens in the case of goitre; that is, it would entirely disappear if conditions were favorable. If we had goitre in our ponds to any great extent and it was traced, we will say, to overfeeding, and the amount of food was reduced to the proper quantity, the fish, excepting those with which the disease had gone too far, would get well. We never saw any fish die directly from goitre. We found that the fish died invariably from fungus, which was produced, presumably, by the lowering of their vitality because of the disease. Although we found no fish that died directly from goitre, I can understand that in some instances fish might die from it, because of the tumor so choking up the gills that they could not operate properly.

MR. FEARING, Newport, R. I.: Did you find that it came from overfeeding or from bad food? Was it not due to bad food?

MR. MEEHAN: Oh, no. Our food was good—it was always tested.

MR. FEARING: Accidentally you might have used decayed food, might you not?

MR. MEEHAN: No tainted liver, lungs or other food in the slightest degree improper, was ever put into the pond. Every piece was examined before being used. We were very particular about that, because we had some bad experience with feeding tainted meat.

MR. FEARING: That will bring fungus, if it is overfed, every time.

MR. MEEHAN: Yes, overfeeding will bring on the disease, and it was very bad in some of our ponds from that cause; but we found, as I said, that when the food supply was reduced, sometimes as much as one-half, and after thinning out the pond a little, the sickness disappeared.

MR. W. O. BUCK, Neosho, Mo.: I remember hearing the theory advanced that water once infected continued to breed the disease in other fish introduced into the same water. If I understand Mr. Meehan, his experience seems to contradict this; that is, when the water in the troughs and ponds was changed the fish recovered. Is my understanding correct?

MR. MEEHAN: That is right. Of course, I am speaking now solely of goitre.

MR. BUCK: Yes, that is what I had reference to.

MR. MEEHAN: Of course those fish that were fungused badly died, but some of those where the fungus had just started recovered when we used salt; but we never bothered ourselves much about trying to save fungused fish.

MR. BUCK: But if I understood you correctly, you succeeded in saving some of your young fish, or apparently so, by turning in more water, thinning them out, etc. Although they had shown symptoms of the disease they appeared afterward to recover from it.

MR. MEEHAN: This disease, which at the time they called sore throat, was brought to my attention by the station superintendents. This was in February, I think, or the early part of March, and we immediately began shipping those fish out, notifying the people who were to receive them, of the reason, and asking them to make special note of results. The majority of those who sent back word to us reported that the fish were doing very well; that for a short time after being put in the water they seemed languid, but in a little while appeared to be in first rate condition. A few died that were kept in small retaining ponds built by some applicants, so that they could observe the condition of the fish better. Possibly that might have had something to do with the loss, because perhaps too many were put in the small ponds; but I cannot speak of that authoritatively, not having seen them.

MR. BUCK: It seems to me that this point is a vital one to be determined, and I hope some one here may throw more light on it.

If it be true that water once infected will breed the disease in fish afterward placed there, evidently we cannot be too careful about turning out fish even only supposed to be infected. At the station where I am located there has been but little trouble with this disease, notwithstanding the fact that there have been a few cases and that it is necessary to keep the trout in the same ponds year after year. In order to hold them at all it is necessary to keep them close to the spring where they can have a good supply of cold water. Two years ago there were a number of infected fish. Last year we found but two and so far this year only one. Apparently the disease is diminishing in this pond. Perhaps complete draining of the pond each fall may affect the result.

Mr. Meehan: I might refer to some experiences in other places in Pennsylvania. Dr. Marine's investigations indicated that with a change in water and a change in condition the fish recovered; and further investigations were rather against the likelihood of inoculation. However, his conclusions in that respect were by no means complete or satisfactory to him or to us.

One of the places in Pennsylvania in which goitre was exceedingly prevalent two years ago was that of the Blooming Grove Hunting and Fishing Club, a private club in Pike County. They had a hatching house and a number of ponds. I suppose 70 per cent of the fish, or at least a very large percentage, had the swelling of the thyroid in a very pronounced degree. You could pick up a net of fish out of a pond and you would find several of them in that condition. It was there that I sent Dr. Marine when he first came to Pennsylvania to study the subject.

It was found that apparently the chief cause of the goitre was filthy ponds. They were inexpressibly filthy; the fœces and the uneaten food would be simply washed down toward the lower end of the pond, toward the outlet, and would rest there 6 or 8 inches and perhaps more in depth. In fact, it was filthy all over the bottom of the ponds. But that condition has been entirely done away with at Blooming Grove. The ponds are kept clean and the food supply has been somewhat reduced, with the result that goitre has appreciably diminished.

There was another concern in the state, the Penn Forest Brook Trout Company, operating a commercial hatchery in Carbon County, but now out of business. A few years ago goitre prevailed there very plentifully—probably as bad as at the Blooming Grove Hunting and Fishing Club. I pointed out at the time that goitre, which was then commonly called "throat tumor," was caused by filthy ponds. It was found that the ponds contained from one to two feet and even more of inexpressible filth. They had not been cleaned in probably 12 or 15 years. The ponds were immediately drained off and cleansed, with the exception of two or three, and were kept clean thereafter, and goitre diminished very rapidly. I have been told that there is no goitre at Penn Forest now. But that seems to be rather improbable when we consider that they have from 125,000 to 150,000 marketable fish. It is hardly likely that the disease was entirely wiped out, for in all probability when they said they did not have goitre in the ponds, they were referring to fish with the thyroid enlarged; they had not looked down the throat of the fish and seen the inflammation.

We also had goitre at the state hatchery at Bellefonte. It was due there, I believe, to overcrowding rather than to overfeeding (for those fish were not overfed), and perhaps to the ponds not being kept just as clean as they should have been, the superintendent having been ill for a long time. I started housecleaning there, and also thinned out the fish, with the result that the superintendent reported to me last spring that goitre had almost entirely disappeared. I went over the ponds again, netted fish after fish, using the dip net, and found scarcely any traces of the disease, although here and there I did find a fish that had a slight inflammation of the throat. Of course, I found any quantity of old trout that had the swelling, but the inflammation had gone.

Dr. Field, Boston, Mass.: Did you say who the pathologist was who made the investigations?

Mr. Meehan: Dr. David Marine, of Western Reserve University, and Dr. Leonard.

Dr. Field: I asked that for this reason: When the question of the possibility of the disease being cancer came up I placed the matter in charge of the cancer hospital in Boston, in the hands of an eminent pathologist, a cancer specialist, Dr. E. E. Tyzzer, of Harvard Medical School, Boston. We had some difficulty in getting material, but we obtained it at last, and Dr. Tyzzer is at work on it. His report is not yet prepared.

Mr. Meehan: I might say that the results of Dr. Marine's investigations were published in two bulletins by the Department of Fisheries of Pennsylvania. They may be had upon application. One was published last year and one this spring.

Q. Is it generally believed to be a new disease? I can recall it as far back as 1875. I remember when I was a small boy of seeing a trout in an old pond that showed unmistakable signs of this disease.

Mr. Meehan: We have had it for years.

Dr. Tarleton H. Bean, Albany, N. Y.: Some of our stations in New York developed this thyroid tumor, notably the one at Bath, and before that the station at Cold Spring Harbor on Long Island.

Not being able to have the services of a competent bacteriologist or pathologist, we proceeded to change the water supply, because we believed that the origin of the throat tumor lay in impure water. Whether or not it does rest there, the changing of the water supply has eliminated goitre absolutely. Not a case of goitre has been reported for some years from either of those stations. It existed at Cold Spring Harbor 20 years ago at least, and caused the loss of many hundreds of brood fish. At Bath the loss was even more serious. It affected the brook trout and the brown trout more especially, but rarely involved the rainbow trout. A strange circumstance with reference to the spread of the disease, however, was made known in Keuka Lake into which the hatchery stream flows some 4 or 5 miles below the hatchery grounds. A large whitefish brought up from Keuka Lake was found to have a large and well developed throat tumor, not in the usual site on the thyroid, but between the gill laminæ, and on the cartilage from which the gill laminæ spring. I don't remember the name of that cartilage, but that is where the tumor was located for the most part, and only a smaller one on the thyroid proper. Now, how was the disease caused in this whitefish? No one had planted anything except whitefish fry in that lake, and none of those for a great many years. It seemed to me that the fish we had liberated purposely or accidentally in the hatchery stream must have gone down into Keuka Lake and acted as a source of infection to other species. Of course I don't know,—one swallow does not make a summer, one whitefish does not establish a principle; but there was a whitefish, not reared in activity, not associated with the pond fish in any way, except as they may have gone into the hatchery stream and introduced the disease into this lake. It seemed to me from that fact there must be some means of spreading the disease in the water. An impure water supply appeared to originate it. As soon as we cut out that source of supply we got rid of the disease. And furthermore we found, just as you did, that fish liberated in a stream where they had a rapid flow and plenty of water, recovered to the extent of more than 50 per cent. Even the large fish would come back to us clean.

Mr. Meehan: Dr. Bean's remarks about the whitefish remind me of another matter which would indicate the possibility of the disease being communicable in some way, and which perhaps caused me to say that in Dr. Marine's investigation, while he found that it was difficult to inoculate the disease, yet the results were not satisfactory to him or to me.

I have not made any investigation myself in regard to the matter, and therefore will not say that it is so, but it is said that the blue pike in Lake Erie are generally affected, or that large numbers of blue pike in Lake Erie are affected with the thyroid disease. I received that statement, I think, from Dr. Marine and others. I have meant to look into it and ascertain to what extent it was true, but have not yet done so.

It was also stated that along the shores of the Great Lakes that thyroid troubles were quite common among dogs and other animals which were in the habit of eating fish offal, and even among the fishermen themselves along the lakes. Whether there is anything in that or not, I am unable to say.

Mr. W. T. Thompson, Fairport, Iowa: Did you have the same number of fish in each of those ponds always, and were the ponds in which the disease was most prevalent larger than the others?

Mr. Meehan: The number of fish in the ponds depended on the size of the latter. In one series of ponds they were about the same size and each pond contained about the same number of fish. They had originally, of course, been counted in at the average of about 1,500 to 2,000 to the pond. The fish in the ponds in which there was very little disease and in the ponds where the disease was quite prevalent might have been of the same age, because we found the same thing happening among yearlings, among two-year-olds and among three-year-olds—I would not say four-year-olds, because we had only one pond of four-year-olds. We had only two ponds of three-year-olds, but we had 7 or 8 ponds or more of two-year-olds, and 12 or 13 ponds of yearlings.

Mr. Thompson: I think you did not understand my question. What I meant was whether you did not have fishes of practically the same age and number in the ponds.

Mr. Meehan: They were practically the same as to number and age.

Mr. Thompson: It is a fact, is it not, that the fish that were overfed grew much more rapidly than the others?

Mr. Meehan: The fish in each pond were all practically of the same size, because we sorted them very carefully. But the number of fish in each pond was about the same, taking fish of the same age.

Mr. Thompson: In the beginning?

Mr. Meehan: Yes, all the way through. Whether they were fingerlings, yearlings, two- or three-year-olds, we held about what we believed to be the number of fish capable of existing in health in that particular pond.

Mr. Thompson: The point I want to bring out particularly from a fish-cultural standpoint is this: We believe, of course, that prevention is much better than cure. I am "from Missouri," and I have to be shown where good generous feeding of young fish is detrimental to them provided growth is not so rapid as to cause overcrowding of the ponds. Take two ponds, each containing 2,000 fish of the same age and size, feed the first lot twice as much as the other, and that lot of fish is bound to grow beyond all comparison with those fish fed but half what they will eat. Consequently, in the course of a few weeks or months, as the case may be, the first pond, while containing but the same number of fish, is going to be very badly overcrowded, and, of course, will then suffer all the consequences due to overcrowding, while the other one remains in a normal condition. You can't keep 2,000 fingerlings no. 6 in a pond intended for that number of fingerlings no. 3 or no. 4.

I believe Mr. Meehan spoke of this trouble as occurring at one of the hatcheries during the absence of the superintendent, and he likewise said that all food before being put in the chopper was examined, and the tainted parts excluded. Now, if the superintendent was absent and this condition came about, is it not possible that the men may not have been quite as careful as they should have been in excluding tainted food; or, on the other hand, it might have been kept a day or two too long before feeding and thus acquire a taint. Granting that the fish were overcrowded and fed tainted food, unquestionably such conditions would bring on disease, but if they were simply fed generously, had a sufficient water supply, the benefit of clean ponds and plenty of range, I would hesitate to endorse any claim that the mere full feeding was the cause of the disease, since my own experience in feeding fish shows the contrary. At one period in life I was engaged in stock raising, and the same principle holds true there. I have found that in every instance when fish or young of any kind were fed generously and with a degree of intelligence and given proper surrounding, they were the very best of their kind. Our breeders of cattle, horses and all varieties of live stock are good, generous feeders, and they produce the finest specimens of the various kinds of stock they handle. My experience has been that when human beings, stock, fish or anything of the kind are underfed, you then bring about a condition that begets disease; also often when such conditions prevail you find other factors lacking, such as cleanliness, etc. I am not referring, of course, to any particular instance; this is a general statement. Most emphatically, I am not prepared to indorse any statement that generous feeding, with good food, will cause disease, provided all the other conditions are right. I think there are a number of fish culturists here who will bear me out when I claim that when fish are generously fed and thinned often enough—and that is very often when they are heavily fed—there will be produced a better fish, likewise there will be less disease and less death than exists among those that are underfed.

Some years ago I presented a paper along these lines before the Society, giving a detailed account of experiments conducted at Nashua, N. H., to ascertain the effect of feeding on growth and egg production. We found in every instance that those best fed made not only the largest rate of growth, but had the smallest death rate; while they likewise produced a very much larger number of eggs.

The fish I have reference to were the long yearlings, 18 or 20 months old. We found those given practically all the food that they would eat made a phenomenal growth and each one of the females—100 per cent—produced spawn. The average per fish being 900 and over. This is much more than we get out of our average aged brook stock.

We do not want it to be heralded about that this Society or any member of it believes the feeding of good untainted food in generous quantities—some might call it overfeeding—produces disease. We believe in prevention, therefore we believe in generous feeding to produce strong, healthy fish immune from epidemics, which will produce good results when placed in the public waters. I would like to hear from other fish culturists on this subject.

Mr. Meehan: While it is possible, of course, that we have been mistaken, and the fish really were overcrowded, it is still peculiar that there should have been a less degree of disease in the ponds in which there had not been the heavy overfeeding. I might say that the overfeeding was to such an extent that it was beyond what the fish ate. Would not that naturally be supposed to affect the fish in the ponds below where one might expect that the unconsumed food might contaminate the water and spread the disease? But it did not. Of course the stuff was removed every day even there. It would wash down and was all taken out.

There was another suggestion about the tainted meat. Of course there is a possibility that there might not have been the closest attention paid to the inspection of the meat, but the presumption is that there was, because it was the man who was left in charge that inspected the meat, and not the man who had the fish in charge.

MR. THOMPSON: When the cat's away, the mice will play.

MR. MEEHAN: So that it does not naturally follow that carelessness in the one would mean carelessness in the other. It is exceedingly rare that we now ever find any tainted meat, for in the past we have thrown back consignments on the hands of the shippers because of their not being just what they ought to be. In the past we used to have many plucks affected by tuberculosis, but we have practically none of that any longer, because I suppose of the government inspection. The only trouble we have ever had of late years was where meat might spoil on the road. We have it coming now actually frozen when it arrives in the summer months, coming as it does in refrigerator cars. We use large quantities at our Bellefonte hatchery. The cost of food alone is $1,200 a year, so that it pays the company from which we buy the meat to send it to us in good condition. If any quantity of it is shown to be bad at any time the whole shipment is returned.

MR. THOMPSON: It often happens that food spoils rapidly after being cut up. It is not the ponds through which floating particles pass that are contaminated, but those where the food refuse sinks to the bottom and collects in the corners; here you have contamination to a much greater degree than with the surface filth which passes off. My contention was and is that these fish which have been heavily fed are the best fish.

Now, by heavily feeding a lot of fish, I do not mean to *feed the pond;* I believe in feeding the fish alone. When fish have taken all they will eat, any additional food simply falls to the bottom and is properly termed: "Feeding the pond." I do not believe in or endorse this for a moment. If these conditions prevail, they certainly would and should bring disease and death. My contention in this whole matter is simply that young fish, say under a year old, cannot be overfed, provided they have a plentiful water supply and good range—I mean in a practical way. Of course I do not claim that a man cannot stand at a pond and deliberately overfeed the fish.

MR. MEEHAN: I agree with you on that point. The disease appeared with greatest severity in fish over a year old out in the ponds. The fingerlings apparently all recovered, and they were not affected by the fungus at all. There was no trouble of any consequence among those fish. It appeared among the yearlings, and two-, three- and four-year-olds, and not among the very young fish. I am like you, a great believer in feeding fingerlings with all that can be gotten into their little bellies.

Mr. Thompson: When they are past the yearling age they can be overfed when kept in confinment. There is no question about that. We always feed our fingerling trout fry generously three times a day.

Mr. S. W. Downing, Put-in Bay, Ohio: One word in regard to the prevalence of goitre among fishes of the Great Lakes to such an extent that the fishermen themselves are affected by it. I was a practical fisherman myself for 25 years and have been associated with the work for the last 40 years, and we know that the fishermen usually eat about their weight in fish once every six months, but I have yet to see the first fisherman that was affected with goitre.

Mr. Meehan: I am glad Mr. Downing can back up my unbelief in the story; I did not believe it myself.

DEFINITE RESULTS OF SURVEY WORK ON THE ILLINOIS RIVER

By Stephen A. Forbes

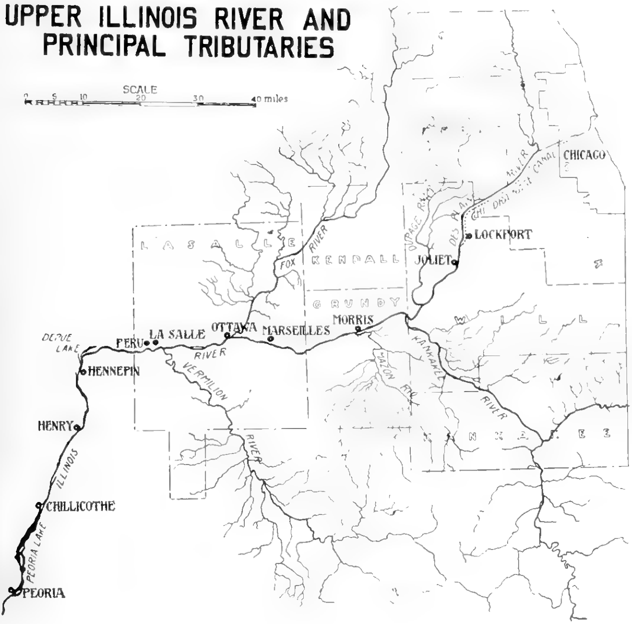
My excuse for appearing before you is that I am conducting a Natural History Survey of Illinois, under authority of the State Legislature and by virtue of appropriations from the state, with instructions to give especial attention to subjects of educational and economic importance. In this survey work, we have been, during the past year, giving particular attention to the aquatic life of the state, and especially to that of the Illinois River; and we have brought out some rather definite results which have such a general and important bearing upon the whole science of fish culture and the conservation of the resources represented in the principal rivers of the country, that I think it worth while to call your attention to them.

One of the things we have undertaken to do is to learn as much as possible of the breeding grounds and habits of some of the more important fishes. For that purpose I have had upon the breeding grounds of the fishes of the central part of the Illinois River, during the breeding seasons of the last two years, two men—Mr. R. E. Richardson, with Mr. H. C. Allen as his assistant—who have fairly lived in a boat, going over the grounds where fishes were depositing their eggs, where the fry were hatched, and from which the fry must escape if they were to survive. Their object was to learn everything possible with regard to the whole process, and also to determine what was the fate of the eggs and what was the fate of the fry. I cannot give you full details, but will mention two facts.

The carp is the most abundant fish in the Illinois River, giving us $412,000 of income in 1908, while all the other fishes together gave us only $309,000. The most important breeding ground for the carp which we have found on the Illinois River is an overflowed field which was commonly in corn before the Chicago Drainage Canal was opened, and which is now under water during the greater part of the breeding season of our Illinois River fishes. In this field Richardson found that about 1,500,000,000 eggs were deposited on something like 600 acres of area. This number was arrived at by counts of the eggs on carefully selected measured areas, multiplied by the ratio of the measured surfaces to the total acreage on which eggs were deposited. Approximately 90 per cent of this billion and a half of eggs were killed by fungus infection in 1910, and so failed to develop. In 1911 the water of the river was unusually low, and only about 300 acres of this tract was covered at the breeding season, but the percentage of eggs destroyed by fungus infection was even greater than that of 1910, amounting, by Richardson's counts and estimates, to 98 or 99 per cent. It was noticed that where an egg lay in contact with a bit of rotting vegetation or other decaying debris, it was almost certain to be fungused; but where the water was comparatively clear and clean, and the weeds were fresh, practically all the eggs hatched—a point of special importance in view of its bearing on the care and management of both natural and artificial breeding grounds of fishes. The saprolegniaceous fungi which kill the eggs and the young fry of fishes, and sometimes older fishes as well, live primarily upon dead organic matter in the water, and do not require a living host; and they can be conveyed from the dead organic matter in the water to the living eggs or the living fry.

One result of our season's work was to confirm an opinion which I have had before that the productivity of the principal waters of the state can only be maintained and developed when the state gets control of certain selected important breeding grounds of the most important species, and takes care of them as it would of any other property; that it will not do to leave these matters to mere chance.

Another thing of particular interest is the fact that we found many nests of large-mouth black bass in the breeding waters supervised; and that here also it depends largely on the surroundings of the nests and on the course of events, whether the eggs shall hatch or become fungused. The black bass prepares its nest in advance, sweeping off the rubbish and laying bare the roots of the water plants among which its nests are commonly placed, and its eggs are much less subject to destruction in this way than the eggs of the carp, which are thrown out indiscriminately and without previous preparation. Furthermore, as we all know, the black bass takes care of its nests and looks after its fry at first, so that the bass has a great advantage over the carp in respect to the survival of its young.



Apparently as a consequence, the product of black bass, according to the United States census of this year, has risen from $11,000 for the Illinois River in 1899 to $58,000 in 1908, when the census statistics were obtained.

That perhaps is enough for that branch of the subject.

I made last year a statement with regard to the plankton production of the Illinois River under existing conditions as compared with those that obtained before the opening of the Chicago Drainage Canal. I simply said to you at the New York meeting, I remember, that the plankton product was larger now than it used to be before the Chicago canal was opened, bringing in an enormous amount of lake water and sewage. We now have our data in more definite form, and can compare the plankton product per cubic meter of the water of the river before and after the opening of the drainage canal. We found that the product was between two and three times as great per cubic meter of the water of the Illinois River in 1909 as it was before that canal was opened; and the bass fishery and the carp fishery, and the product of the whole river system, have risen in something like a corresponding ratio. I have some statistics here which I will not trouble you to read, but will pass that point with the general statement just made.

Now it might seem that we could rest content with the present condition of things, so far as Chicago sewage and the drainage canal are concerned; it might seem that it was like looking a gift horse in the mouth to go further. Nevertheless, I thought it my duty to look into the horse's mouth—to see, that is, what the conditions are where the drainage canal empties into the Illinois system; and the greater part of our work this season has been directed to that point. R. E. Richardson, biologist of my staff, and C. H. Spaulding, chemist, worked during midsummer from station to station on the upper 93 miles of the Illinois, from its origin at the junction of the Kankakee and the Des Plaines to the upper end of Peoria Lake.

The Des Plaines River comes down from the north practically parallel with the shore of Lake Michigan, and receives the drainage canal from Chicago between Lockport and Joliet. Our observations were directed to ascertain what were the conditions in the drainage canal and in the Des Plaines River at the mouth of that canal, at the mouth of the Des Plaines River after the natural waters of the Des Plaines and those of the drainage canal had mingled; at the mouth of the Kankakee, where we had as near the natural Illinois River water as we can now get; and then in the stream below the union of these two rivers to form the Illinois itself.

We found a remarkable contrast between the waters of the Des Plaines River and the drainage canal where the two came together, and not the kind of difference one might expect. The canal water was comparatively clean and clear to the eye, the highly dilute sewage it contained being still too recent to have undergone any very important part of its decomposition.

The Des Plaines River, on the other hand, was loaded, just above the mouth of the canal, with sewage products in an advanced stage of decomposition, and contained also an immense quantity and considerable variety of the organisms which live in impure water and cannot continue for any great length of time in water which is not contaminated. These same organisms, of course, characterize the water of the Des Plaines below the mouth of the canal.

The marked difference between these two waters was accounted for by the fact that the Des Plaines, as it came down from the north past Chicago, was receiving, undiluted, the sewage of a number of large suburbs of that city. Its current was slow under the low-water conditions of last summer, the weather was very hot, and the stream was shrunken by drouth. The sewage had consequently, time to reach an advanced stage of decomposition and to develop immense numbers of septic organisms before it reached the mouth of the canal; whereas, in the water of the canal itself the sewage was still in a comparatively fresh and recent state, as was shown by its still recognizable ingredients, such as lumps of tallow, chunks of human excrement, pieces of toilet paper, watermelon and muskmelon seeds, broken grains of corn and wheat, and finely chopped straw—all coming down practically unaltered through the whole length of the canal. There was some development of the characteristic organisms of decomposing sewage, but in an insignificant amount as compared with that of the Des Plaines. There were even some lake fishes in the drainage canal, one a lake minnow represented by several fishes still living, but in a dying state.

Immediately below the mouth of the canal we have in the Des Plaines a mingling of these waters, and in the Illinois River itself, below the junction of the Des Plaines and the Kankakee, the septic contributions of the former stream are largely diluted by the comparatively clean water of the latter. Nevertheless, we had in July and August, what may be called septic conditions for twenty-six miles of the course of the Illinois from its origin to the Marseilles dam. At Morris, which is on the middle part of this section, the water, July 15, was grayish and sloppy, with foul, privy odors distinguishable in hot weather. The current was about four miles an hour, and the stream was in many places bubbling with gases arising from the bottom. Putrescent masses of soft, grayish or blackish, slimy matter, loosely held together by threads of fungi, and densely covered with bell animalcules, were floating down the stream; and chunks of this material, from the size of a walnut to that of a milk pan, occasionally rose to the surface, evidently borne up by the gases developing beneath them.

The gases from the bottom sediments of the stream were obtained for analysis, and were found to be identical with those from septic tanks of sewage systems, composed of the same elements present in similar ratios. When the analyses of these river gases were brought into the same table with those of gases obtained from the sludge in septic tanks of

Illinois towns, it was impossible even for an expert to tell which of them came from the sewage system and which from the Illinois River at Morris and Marseilles.

The gases of the water itself are, of course, more essential, since it is upon these that the fishes must depend for respiration. We found that at Morris the dissolved oxygen of the water amounted to an average of 9.8 per cent of saturation, the ratios ranging from ½ per cent to 3½ per cent of saturation July 22, and from 9 per cent to 21 per cent from July 28 to August 31. By "saturation" we mean the amount of oxygen which the water will take from the air by simple contact with it, so that oxygen equilibrium is established between the air and the water. Sometimes the water will contain an excess of oxygen, through living plants immersed in it and giving off oxygen in the sunlight. When we found at Morris the ratios of gas mentioned above, we found in the waters of the Kankakee, nine miles above, 112 per cent of saturation. There was more oxygen there than the water would take directly from the air. These comparisons show that from 5/6 to 99/100 of the oxygen of the river water was being used up, at this time, by decomposition processes going on within it at this point.

There were, of course, no fishes here, or any other animals requiring oxygen. Fishes were abundant in a small tributary of the river at Morris known as Mazon Creek, and in a slough at its mouth. Carp were especially numerous in this slough, but they did not venture into the river under these midsummer conditions.

Going down the river from Morris sixteen miles to the first dam crossing it, at Marseilles, we found an average of only 7.5 per cent of oxygen-saturation, and, of course, there were no fishes anywhere in this section of twenty-six miles. At the Marseilles dam the water had a fall of from 12 to 14 feet, and above this dam, of course, there was a semi-stagnant pool through which the water flowed very slowly. This pool served as a kind of settling tank, such that the larger organic particles fell to the bottom and the water went over the dam comparatively clear of sediment. Such suspended organic materials as continued in it were pulverized at the dam and the water was thoroughly mixed with air, so that an eighth of a mile below, instead of the 7.5 per cent of oxygen found above, Spaulding's analyses gave us 65.4 per cent. A large part of this was really contained in air mechanically mixed with the water but not actually dissolved; but three-fourths of a mile below this free air had escaped, and the permanent content of dissolved oxygen there was 24.8 per cent. From that on down the river as far as we went the dissolved oxygen increased, under ordinary conditions, until, at Chillicothe, the lowest point at which we made collections, a maximum of 49 per cent was reached. Notice, now, that at the lower end of this ninety-three mile section of the river, we obtained less than 50 per cent of saturation with oxygen, while just above the upper end, in the mouth of the Kankakee, we got 112 per cent, showing that the water did not return to anything like its normal stage of oxygen saturation through these ninety-three miles.

To this rather long and complex account I will add only a remark or two as to the effect of these conditions on the fish life of the stream.

In the first place, the upper twenty-six miles of the Illinois was at this time practically a great septic tank for the city of Chicago and its suburbs. Our studies were made, however, in a season of continuously low water and unusual heat. What the facts would be under other conditions it will take further investigation to determine. At the foot of the dam below Marseilles, where the water has been aerated and partially purified, carp are said to appear almost continuously, and black bass are caught here occasionally. Notwithstanding the deficiency of oxygen, fish were found all along down the stream in increasing numbers as we went farther south. Fortunately, the upper end of this river is not the fish-producing end. There were some minor fisheries here originally, but all the important commercial fishing is now carried on far down the stream, the first important point being Hennepin, fifty miles below the mouth of the Des Plaines.

DISCUSSION

Dr. George W. Field, Boston, Mass.: Did you make any observations on the rapidity of nitrification in the stream?

Dr. Forbes: We did not.

Dr. Field: What is the condition at the dam at the mouth of the Kankakee?

Dr. Forbes: There is an unfinished dam at the mouth of the Des Plaines. Some years ago the Economy Light and Power Company began to build a dam at this point with a view to creating a water-power there, but litigation arose in resistance to this procedure, and the work was stopped and the dam remains unfinished. It extends effectively across a part of the stream, however, and thus acts as a wing dam to concentrate and to hasten the current of the Des Plaines, throwing it with some force to the other side of the Illinois, and mixing the waters of the Des Plaines and the Kankakee more thoroughly than would be the case if they were allowed to flow down gently side by side. They are not completely mixed, however, even as far down as Morris, some nine miles below, as was shown by a comparison of the oxygen content of the water at the two sides of the river. That which would naturally be Kankakee water, if left uncontaminated, contained, at Morris, twice as much oxygen as that from the other side of the river, corresponding to the Des Plaines. Nevertheless, this mingling of the waters and consequent dilution of the sewage content doubtless works to the advantage of the stream by bringing about a more rapid decomposition of its organic contents than if its sewage-laden waters flowed down undiluted, side by side with a comparatively clear current.

One other point of special interest, to which I have not alluded, came out in the course of our analyses. At one time during this period a heavy rain fell which brought the river up at Morris some six or eight inches. Fortunately, we had begun our chemical determinations some time before this rise, and we continued them through it and for a considerable time thereafter, so that we were able to see what the effect of these flooding rains was upon the oxygen content of the water of the river. This went down about 50 per cent the whole length of the stream as a consequence of this flood, the difference between the former oxygen content and that after the rain growing greater as we went down the Illinois, so that it was greatest at Chillicothe.

This was a rather surprising fact. Here was a great and sudden afflux of flood water which one would suppose to be comparatively free from organic matter, in which, consequently, there would be little decomposition in progress, and the oxygen content of which would hence be much higher than that in the water of the stream itself. (There is little oxygen in waters loaded with organic contaminations, because the oxygen is used up by the processes of decomposition.) It was evident, from the facts, however, that the general flooding and scouring of the surface of the country, the washing off of the streets of towns, and the flushing out of sewers, which results from a heavy rain, brought into the river water containing larger ratios of organic matter than the stream itself, so that the stream became more heavily contaminated by reason of these flooding rains.

Now I have noticed, and most of you have no doubt had similar experiences, the occasional occurrence of what may be called epidemics among the fishes of our rivers in midsummer. Several cases have been reported to me where fish were dying in myriads along the course of a river in hot weather, piling up in rows along the banks of the stream in a way sometimes to create a great nuisance, requiring, perhaps, the active work of health departments to dispose of it. I remember, for instance, some years ago that it took a considerable number of wagons three days to haul away the dead fish that lodged on the bank of Rock River where it flows through the town of Rockford. All these occurrences come, so far as I have noticed, in hot summer weather followed by a series of heavy rains—especially violent thunder storms—which wash off the country and wash out the sewers, and overload the streams with organic debris, the decomposition of which must take the oxygen out of the water.

Quite lately there has appeared in one of the European fisheries journals an article reporting the investigation of just such an occurrence there. The writer of this article was fortunate enough to be on the ground at the time, competent to investigate it thoroughly, and with the necessary facilities at his command; and he found what I have supposed heretofore to be the case—that the oxygen content of the water of the stream in which the fish had died by myriads fell off almost to nothing, so that the fish were simply suffocated there by reason of the consumption of the oxygen of the water in the decomposition of the organic matter carried in by this hot-weather flood.

Prof. L. L. Dyche, Pratt, Kan.: I think the Society owes about three votes of thanks for this most elegant address. I would like to comment a little on this paper, but I do not know in beginning whether to go forward or backward.

Speaking about floods, I have had three or four cases reported to me during the past summer—we had hot weather in Kansas, followed in certain localities by heavy rains—where people insisted that after a heavy thunder storm, water spouts, etc., lightning had struck the water (four or five cases were reported) and killed tons of fish. We had no faith in the contention, but answered by saying we thought it was the bad condition of the water; the exact explanation we could not give, as we did not visit the localities and did not fully understand the conditions. However, Dr. Forbes' paper has thrown much light on the subject; and when we hear of lightning killing fish in the future, the information in this paper will enable us to give more reasonable information on the subject.

We have prepared a bulletin primarily for the people of Kansas, on "Ponds, Pond Fish and Pond Fish Culture." Part I on "Ponds" and Part II on "Pond Fish" are already published. Any of you gentlemen can receive these bulletins and have your names placed on the mailing list. We will send them to you if we can secure your correct addresses. If you do not receive them please let us know.

We have made some observations that have been recorded in these bulletins. The observations include some notes on rock bass that were spawning near the shore, where the swamp grass hung over near the places where the fish spawned. Many of these nests were only a foot from the shore in water not more than six or eight inches deep; and a very considerable number of these rock bass made nests where more or less dead vegetation such as grass and leaves existed. The fish would hollow out a place and deposit their eggs on the dead leaves, grass, etc., but only a small percentage of the eggs hatched. In fact, in some instances all the eggs would be covered with fungus. It bothered me a great deal to know why the eggs died in so many instances.

We read the reports of this Society and got much information concerning the spawning habits of the black bass and other fish. We do not have small-mouth bass in Kansas. We have undertaken to raise the small-mouth and it does well in the ponds, but if these fish are placed in our waters in competition with the large-mouth bass they disappear. I do not know what happens, but they disappear. At Lake View, near Lawrence, Kan., the government stocked 150 acres with small-mouth black bass some 15 years ago.

We have fished in that lake more than thirty years and never caught but one small-mouth black bass. This lake has always been well supplied with the large-mouth black bass, but the small-mouth black bass does not seem to thrive in the same waters in Kansas that are well adapted for the large-mouth variety. We notice in the reports of this Society that special gravel beds have with more or less success been prepared for the use of the black bass during the spawning season. We prepared a number of beds for black bass to spawn on. We wanted information suitable to and in harmony with the conditions of our own state. Many farmers in Kansas are raising fish and want information in regard to pond fish culture. Coarse sand and gravel was placed in these beds, the gravel ranging from the size of peas to marbles. These sand and gravel beds looked good enough to attract any spawning bass. Did the black bass come and spawn on those beds? No. They went just outside of the beds, where moss, grass and other small water-plants grew. They removed part of the grass and moss and the softer mud. In these shallow basins, lined with stems of grass and moss and their roots they deposited their eggs. Not a single bass, so far as observed, spawned on the gravel beds. These beds may be all right for some localities, but bass in Kansas streams and lakes do not seem to care for such spawning beds.

Thus far all the bass beds we have seen have been in places where some vegetation grew, and the beds were lined with fine roots and pieces of growing vegetation. The material in the beds looked as though it had been wallowed or washed down to conform with the outline of the basin-shaped beds. On the strings of moss, roots, etc., the eggs had been deposited and could be seen adhering to the moss and grass roots. When the weather was favorable nearly all these eggs hatched. Where grass had been allowed to grow from two to four feet high along the shore for protection of young fish and had not been removed, a certain amount of dead material, such as leaves, grass stems and other matter, was found in the nests. In such places, where the water was clear enough to make observation, it could be seen that from 25 to 75 per cent of the eggs were affected by the white fungus. We did not know it was on account of the dead leaves and grass; however, Dr. Forbes has given us most valuable and much needed information on that point. Knowing that it is a bad thing to allow this dead material to accumulate where spawning beds are to be made, such material can be removed in time so that it will not do any harm.

We allow swamp grass to grow 3 to 5 feet high along the edge of the ponds for two purposes, one to keep the waves from cutting the banks when the wind blows hard, and the other is to protect the young bass that come to the edge of the ponds to feed. The young fish feed for the most part during the morning in the grass, moss and weeds that grow near the shore line. During the heat of the day they disappear and apparently go to hiding places among the water plants in deeper water.

The ponds at the Kansas state hatchery are all well stocked with goldfish. We put them in with the bass, crappie, bullheads and bluegills. It seems impossible to raise enough goldfish to supply food for the other fish. Bass seem to be very fond of goldfish. Old bass will eat them apparently in preference to almost any other kind of food. Something like 5,000 goldfish from 3 to 6 inches in length were placed in a pond during the spring with about 250 spawning bass. When the pond was drained early in September we found only four old goldfish. However, during the summertime we saw many young goldfish along the edge of this five-acre pond. We also bred crappie in the same ponds with large-mouth black bass.

About 100 giant crappie were placed in a five-acre pond with about 250 black bass. When the pond was drained in September it yielded over 30,000 young crappie and over 20,000 young black bass. Many of the young bass were from 4 to 7 inches in length. The larger specimens were feeding upon the smaller of their own kind and upon the young crappie. When we killed almost any specimen of the larger young bass, a smaller bass or one or two young crappie would be found in its stomach. This pond was full of growing vegetation and it was not possible to handle or separate the fish until it was drained. However, we got over 50,000 young fish from it.

During the spring many goldfish also spawned in this pond. They came within from 6 to 15 inches of the shore to spawn. They seemed to be afraid of the bass and observations went to show that they had good reasons for their fear, for the bass were seen swimming near the shores watching for them. When a goldfish was thrown in the water a few feet from the shore it was usually grabbed by a bass. The goldfish had little roadways in the moss near the shore where they traveled, and along these roadways in the fine grass and moss they deposited their eggs. Soon after the goldfish eggs hatched, schools of little bass could be seen using these same roadways, and the little goldfish began to disappear. Examination of some young specimens of bass went to show that they were not only feeding upon young goldfish, but were eating their own kind. Young bass seem to begin to feed upon one another when they are scarcely two inches long. One of the serious problems about black bass culture at the Kansas hatchery is the cannibalistic nature of the young and growing stock.

Mr. Meehan: I do not want to go on record as saying positively that fish will or will not be killed by lightning, but I would like to give two bits of experience that I have had as showing that under some circumstances at least fish may be killed by lightning.

Professor Dyche: I am not positive on the subject, for I always doubted the lightning theory.

Mr. Meehan: A few years ago at one of our hatcheries at Allentown, since abandoned, we had some ponds containing brook trout, others containing rainbows, and others containing brown trout. Very little surface water got into these ponds. They had a very abundant supply of spring water. Now after every severe storm whenever lightning would strike the ground within a short distance of those ponds, a large number of the brown trout and the rainbow trout would be killed. Some of them, after the storm was over, would be found dead, others struggling around in the pond very languidly, twisted and contorted and apparently something wrong with them. They would die within a few days. The loss in these ponds after each big storm, where lightning had struck the ground within a few hundred yards of them, was great, sometimes as many as 100 or 200 of those brown trout or rainbows would be found dead. The brook trout, however, rarely were killed. The indications were that they had not been shocked; and it was found always that it was either the brown or the rainbow trout, or the fish which touched the stone on the bottom of the pond, which were killed. So wherever the brown or brook trout were swimming free in the ponds they escaped, but wherever the stones were touched they were killed.

During the summer I received letters from all over the state about the death of fish in the streams, usually attributed to dynamiting. But last year I received a letter and also specimens of fish from a stream in the northwestern part of Pennsylvania; and when we made an examination of them they bore the same earmarks that the brown trout and the rainbow trout did that were killed at the Allentown hatchery. I made an investigation and found that there had been a tremendous thunderstorm and that lightning had struck the trees and ground in several places along the shores of that stream—not the stream itself—but it struck on the shore and the fish, as I say, bore the same marks as those fish which were killed in the Allentown ponds.

PROFESSOR DYCHE: I have been fishing since I was a boy, and in four or five instances I have stood on the banks of streams fishing where lightning struck a tree right on the shore of the creek. In one instance a large elm was struck and a strip of bark and splinters was torn out from the top to the bottom of the tree which was actually split in places. I never knew of a fish coming to the surface on account of those heavy strokes of lightning along an ordinary stream. If it is possible to kill such fish as bass, catfish, buffalo, or carp, the lightning must be right close to them. I do not know about the trout.

MR. MEEHAN: The fish from northwestern Pennsylvania to which I referred were suckers and catfish almost entirely; although there were said to be two or three bass. They were fish that would be naturally on the bottom of the stream; and this stream is very rocky and stony.

DR. FIELD: I wish to say a word in appreciation of the work of Dr. Forbes and the Illinois Commission in this line. It seems to me that it is the best that has been done in this country. We in the United States do not at all appreciate the importance of this type of economic work. We hear a great deal about the increased cost of living and here we are on the one side throwing out the very material which is most needed on the land, and, more than that, by means of this same material we are destroying the fish in the streams. I have just come from the Conservation Congress at Kansas City where the dominant tone was the conservation of the soil; and yet almost from the very windows of the convention hall you could see men carting off the manure from the stock-yards and dumping it into the streams! It is a common practice to dump manure into streams instead of putting it on the land.

In the northeastern section of the United States conditions are complicated by the fact that the sewage is mingled with a very large amount of manufacturing waste, and is not in so dilute a condition as is that of Chicago; and though the conditions in the Illinois River are bad, they are infinitely worse in the manufacturing communities in the east. Yet our streams are capable of producing as many fish per acre, or as much fish food per litre of water, as are the streams of any section of the country. The Blackstone River in Massachusetts is notoriously the worst polluted river in the world.

Now our section of the country does not appreciate the importance of taking up the work, such as Dr. Forbes has done. He has shown that under certain conditions the fish in these streams may be increased five, ten, twenty, or even a hundred fold or more, by careful attention to these matters. I believe thoroughly that this Society ought to go on record very strongly in some way in regard to this matter of pollution. It is, in my opinion, the one big question with which the fish interests are confronted, not alone on the streams but on the coasts where this polluting material goes into the salt water. Now unless it is nitrified and oxidized before getting to the bottom of the salt water, it remains there as a slimy ooze; accumulates practically never to disappear, because of the deficiency or even absence of oxygen.

We have had that experience in Boston and New Bedford Harbor, and many other places. Our best illustration is perhaps Boston Harbor, where by the expenditure of about $27,000,000 the sewage of a large district has been collected and discharged into tidal waters. We found upon examination that the shellfish production of Boston Harbor should be in terms of food value normally not less than $400,000 a year; and $400,000 a year will pay the interest on a pretty large sum of money. This source of food and wealth has been rendered not only worthless, but even made a positive menace to the public health, by becoming a source from which polluted clams are marketed. And this, too, in addition to the fact that this nitrogenous material, which is extremely valuable as a fertilizer, has been actually wasted.

When we note that Berlin and other European cities are conducting their sewage on to agricultural land and renting that land for a price up to $35 an acre, it is time for the American people to open their eyes.

Mr. Meehan: I suggest that you prepare a resolution on this line for submission to the Society. I think it should be done perhaps this afternoon and then it can be acted upon. I think this is a very important matter.

Dr. Field: I will do so.

Dr. S. P. Bartlett, Quincy, Ill.: I want to go on record as being heartily in accord with the last speaker's remarks. Many of our most beautiful streams in Illinois today are simply sewers. Where great quantities of black bass used to be taken, we have nothing but cesspools. I should like to see the Society adopt a resolution on this subject, so that we can get a start with our legislators. I am heartily in accord with the sentiment.

LICENSES FOR HOOK AND LINE FISHING

By T. S. Palmer

Licenses for commercial fishing are so generally required as to excite little comment, but the requirement of licenses for angling or fishing with hook and line is comparatively recent, and at present in an experimental stage. By many persons the idea is not regarded with favor; some consider it an interference with their constitutional rights and others view it as an unnecessary and burdensome restriction. It should be remembered, however, that licenses for hunting game for sport as distinguished from market hunting licenses have been gradually adopted during the last 15 years until at present they are required of residents in 34 states and 6 Canadian provinces, and in the case of non-residents are required in all the states and all the Canadian provinces.

STATES REQUIRING HOOK AND LINE LICENSES

At present at least 11 states, chiefly in the northern Rocky Mountain and plains regions, have adopted some form of angling license. One of the first of these states was Nebraska which, in 1901 (chap. 36), required the same license for fishing as for hunting either by residents or non-residents. Idaho and Montana followed in 1905, but the Montana license proved unpopular and was repealed at the following session of the legislature only to be re-enacted in 1909. The 11 states which now have hook and line licenses, with the dates of adoption of the law, are as follows: Arkansas (1911), Colorado (1909), Idaho (1905), Minnesota (1911), Montana (1905), Nebraska (1901), Oregon (1909), South Dakota (1911), Utah (1907), Wisconsin (1909), and Wyoming (1911).

Licenses in Arkansas, Colorado, Minnesota, South Dakota, Wisconsin and Wyoming are required only of non-residents and those in Arkansas are local and limited to two or three counties.

FEES

The fee for the privilege of angling is nominal, usually $1, but sometimes more in the case of non-residents—$2 in Idaho and South Dakota, and $5 in Oregon and in Clay County, Ark. The object of a fee is not to prohibit fishing, but merely to require those who enjoy the privilege to contribute something toward the maintenance of the work of fish propagation and protection. In Wisconsin the law provides that one-half the proceeds of hook and line licenses shall be credited to the fish commission, which has charge of the work of fish propagation, and one-half to the hunting license fund which is the fund from which expenses for warden service are paid.

How large a fund a fishing license will produce is uncertain for the reason that no state has yet required separate hunting and fishing licenses from both residents and non-residents. The receipts from the non-resident license in Wisconsin were $8,606 in 1910 and $8,560 in 1911. The adoption of the combination license for hunting and fishing in Idaho has greatly increased the number of licenses issued as will be seen by comparing the returns for the years 1903 to 1910. The first hunting license law was passed in 1903 and the first fishing license in 1905; in 1907 a separate non-resident fishing license was provided with a fee of $1, and in 1909 the fee was increased to $2. Statistics for the first two years show receipts for hunting only while those for other years show receipts for both hunting and fishing.

RECEIPTS FROM HUNTING AND FISHING LICENSES IN IDAHO

Year	Non-resident fishing	Non-resident hunting	Resident hunting and fishing	Total
1903	....	$1,735	$12,370	$14,105
1904	....	...	13,000	13,000
1905	$1,063	1,040	15,010	17,113
1906	1,606	625	18,074	20,305
1907	2,223	1,020	27,440	30,683
1908	2,219	710	31,831	34,760
1909	4,692	1,380	38,483	44,555
1910	6,180	1,565	44,606	52,351

COMBINATION LICENSES

Most fishing licenses are issued in combination with hunting licenses. The case can perhaps be more clearly stated by saying that in Colorado, Idaho (resident), Montana, Oregon, Nebraska, Utah, and Wyoming the hunting license carries with it the privilege of fishing. The effect of such legislation is interesting. Most hunters are also fishermen and offer no objection to the requirement of a fishing license inasmuch as it entails no additional expense. All fishermen, however, are not hunters, and some find it convenient to go fishing during their summer vacation before the hunting season opens. In the case of non-residents the licensee is apt to regard it as something of a hardship to be compelled to pay fees varying from $5 to $25 and intended primarily to cover hunting, when he cannot or does not care to avail himself of the privilege of hunting.

For statistical purposes the combination license is a distinct disadvantage, as it is impossible to separate the hunters from the fishermen, and although the fishermen usually greatly outnumber the hunters it is no longer possible to estimate even approximately how many persons have taken out licenses solely to hunt game.

MANNER OF ISSUE

The manner of issuing fishing licenses is usually the same as that of issuing hunting licenses. In Idaho and Wisconsin the work is performed by the warden; in Colorado and Nebraska by the commissioner or the county clerk; in Minnesota by the game commission, warden, or county auditor; in Montana and Utah by the warden or justice of the peace; in South Dakota by the warden or county treasurer; in Arkansas and Oregon by the county clerk; and in Wyoming by the justice of the peace. Details of issue in each state are shown in the following table:

Details of Issue of Fishing Licenses

State	Kind of license	Fee	By whom issued
Arkansas—			
Clay County......	Non-resident	$5.00	County clerk
St. Francis County.	Non-resident hunting and fishing on own land...	10.00	do.
	Non-resident, owning no land....	25.00	do.
Colorado	Non-resident or alien, hunting and fishing.....	12.00	Commissioner or county clerk
Idaho	Non-resident or alien	2.00	Warden or deputy
	Resident fish and game	1.00	do.
Minnesota	Non-resident	1.00	Warden or auditor
Montana	Non-resident	1.00	Warden or justice
	Alien	5.00	Warden or deputy
	Resident citizens, hunting and fishing	1.00	Warden or justice
	Non-resident, general hunting and fishing	25.00	Warden
	Non-resident, limited, hunting and fishing	10.00	do.
Nebraska	Resident, hunting and fishing.....	1.00	Commissioner or county clerk
	Non-resident hunting and fishing.	10.00	do.
Oregon	Resident hunter's and angler's...	1.00	County clerk
	Non-resident, angler's	5.00	do.
South Dakota	Non-resident	2.00	Warden or county treasurer
Utah	Resident, hunting and fishing.....	1.25	Commissioner, warden or justice of the peace
	Non-resident hunting and fishing.	5.00	
	Alien do.	100.00	
Wisconsin	Non-resident	1.00	Warden or deputy
Wyoming	Non-resident or alien, general hunting and fishing	50.00	Justice of the peace
	Non-resident, limited, do.	5.00	do.
	Alien, limited, do.	20.00	do.

LIMITATIONS UNDER FISHING LICENSES

Several of the states exempt women and children from fishing license requirements, although no distinction of sex is stated in the laws of Arkansas, Colorado, Minnesota, Montana, South Dakota, Utah, or Wyoming. The exemption of women in the Wisconsin law has caused frequent evasion of the statute and has sometimes rendered enforcement difficult even if it has not materially reduced the receipts. There seems to be no good reason why all adults who care to fish should not pay a license. The age limit varies considerably in the laws of several states. In Idaho exemptions are made in favor of boys under 12, in Oregon under 15, in Wisconsin under 16, and in Nebraska under 18. Exemptions are also made in the case of persons fishing on their own lands. Arkansas, Nebraska, Oregon and South Dakota grant landowners the privilege of fishing or hunting on their own property without obtaining a license.

In the following table are shown the sex and age limitations in the various fishing licenses, and also the dates of adoption and the kind of license, *i. e.*, whether fishing or combination fishing and hunting.

CONDITIONS OF FISHING LICENSES

State	Kind of License	First Adopted	Sex	Age Limit	Fishing or Combination
Arkansas—					
Clay County.....	Non-resident	1911			Fishing
St. Francis County	Non-resident owning land.......	1911			Combination
	Non-resident owning no land....	1911			do.
Colorado	Non-resident or alien	1909			do.
Idaho	Resident	1905	Males	12	do.
	Non-resident or alien	1905	Males	12	do.
	Non-resident or alien	1907	Males	12	Fishing

CONDITIONS OF FISHING LICENSES—*Continued*

State	Kind of License	First Adopted	Sex	Age Limit	Fishing or Combination
Minnesota	Non-resident	1911		21	Fishing
Montana	Non-resident or alien	1905			do.
	Resident	1909			Combination
	Non-resident, general	1909			do.
	Non-resident, limited	1909			do.
Nebraska	Resident	1901	Males	18	do.
	Non-resident	1901	Males	18	do.
Oregon	Resident	1909	Males	15	Fishing
	Non-resident	1909	Males	15	do.
South Dakota	Non-resident	1911			do.
Utah	Resident	1907			Combination
	Non-resident	1907			do.
	Alien				do.
Wisconsin	Non-resident	1909	Males	16	Fishing
Wyoming	Non-resident or alien, general	1911			Combination
	Non-resident, limited	1911			do.
	Alien, limited	1911			do.

PRESENT TENDENCIES

The present tendency seems to be distinctly in the direction of charging both residents and non-residents a reasonable fee for the privilege of fishing, and thus requiring those who enjoy the sport of angling to contribute toward the expense of keeping the streams stocked and patrolled. Heretofore in some cases this expense has been met in whole or in part by receipts from hunting licenses, but such a policy is distinctly unfair to the sportsman and has not met with favor. If the hunter is taxed for his sport it is no more than fair that the fisherman should contribute something for his pleasure, and it is manifestly unjust that the sportsman should be taxed for hunting and compelled to carry the burden of stocking streams for which the fisherman contributes nothing. It is perhaps to offset this objection that the combination licenses have been adopted.

Another equally important tendency seems to be in the direction of reasonable fees and in the reduction of the high non-resident licenses which have been required in certain states. Statistics are not yet complete enough or available for a sufficient number of years to warrant any definite conclusions as to how much money may be raised by a hook and line license but it is reasonably certain that a $1 license for residents and a $2 or $5 license for non-residents will produce ample funds to meet present needs. The simpler the licenses and the easier it is made for the public to obtain them, the more popular will the system become and the larger will be the funds for fish propagation and protection.

THE FUTURE OF OUR BROOK TROUT

By S. F. Fullerton

I am not a pessimist by nature, in fact I would rather look on the bright side of things than on the dark side. Thus when I say that the brook trout, the lordly Fontinalis we all love, is doomed if we do not change our methods and get closer to nature than we have been doing, it must be plain that I am indeed apprehensive. We have been receding from the natural way of keeping our breeders and getting into what I will call the commercial way. Our aim has been to get all the eggs we possibly can from a given lot of breeders regardless of how many of the eggs hatch or the vitality of the fry after being hatched; in other words, we are in the business for the money there is in it. If we are hatching fish for the state it is the showing we can make—the millions we can report as sent to the streams from the different stations. It is not the number of good fish sent out, strong, healthy fish that, when the time comes, will reproduce their kind as their forebears did.

Now let us look at conditions at the average brook trout station. Ponds are prepared of size so as to be convenient when the spawning season arrives. Into these ponds our breeders are put and in nine out of ten cases an insufficient amount of water is furnished to insure good healthy trout. Then they are fed on mush or mush and liver, depending on how cheaply we wish to run the station. The quarters they are in are often entirely inadequate for the number held. The fish cannot get a proper amount of exercise, even if they have the proper food, and when the time comes for them to spawn they produce eggs that hatch puny fish and weak. The percentage of hatch is way below what it should be and those that do hatch hug the screen at the end of the trough, poor weaklings that they are. They have to be nursed and coddled as any other weak infants from weak parents, and if they ever do grow up they have no life, no vitality, and no future.

You say this is a very dark picture. Members of the American Fisheries Society, the picture is true to life. There are exceptions of course, but they only go to prove the rule. Why I have seen eggs, not only one lot but several lots, come from these mush-fed breeders that were dear at 15 cents a thousand, and if we keep this up I can see nothing for the future. Of course there is a remedy and that remedy is right in our own hands. We have the power to stop this method or methods that I have been describing. Get back to nature and nature's ways; provide large roomy ponds with an abundance of pure cold water; introduce into these ponds natural food, the food that the trout like in their wild state; take no eggs from fish that are less than two and one-half years old; get the fry in your stream as soon as they destroy the yolk sac; and never let them taste liver unless it is absolutely necessary to carry them along; then when these fish grow up and the sportsman who perhaps has helped to plant them goes to the stream he finds fish, good, strong, healthy fish that jump for his lure like the trout of the old days.

I am not talking from some imaginary case. I have experimented with liver-fed or mush-fed fish and with fish treated as if they were in their wild state. As for the former I would just as soon catch so many suckers. But it is the future of our trout that I am looking out for. Take any other living thing, from man down, and treat it the way our brood trout are treated and how long would the race last? Only a few generations. You cannot disregard the laws of nature and expect nature to smile on you, for the closer we follow nature the better results we will have. This is true of every living thing.

Now I know that some of you will not agree fully with what I say in this paper, but I do want you, every one who raises brook trout either for the market or for stocking the streams of state or nation, to think this matter over; look at your eggs, look at your fry, and compare the results of both methods of which I have spoken. The government, which is the largest purchaser of eggs from the commercial stations and which has done and is doing such splendid work in stocking our streams, ought to take up this matter, look into it, and see if there is not something to my warning. There should be a demand, before you buy any eggs, that the parent fish should be kept in ponds or a stream that is suitable, and that natural food has been furnished the fish. It will then be only a short time until we are back on the right road from which we wandered a few years ago. Then will the future of our trout be assured.

IS IRRIGATION DETRIMENTAL TO TROUT CULTURE?

By W. T. Thompson

The question of the relation of irrigation to trout culture is necessarily one of comparatively recent date, though irrigation itself is as old as civilization. In the new world, it successfully encountered unique irrigational problems on the high plains of the great west, where the growth of irrigation in recent years has been phenomenal. Few realize even in a small measure how much it has done for this section of our country. Our "Great American Desert" is being rapidly irrigated out of existence. Where it once stood, we now find prosperous agricultural communities, supporting thriving towns and cities.

As public spirited citizens we cannot but take pride in these material evidences of progress. As fish culturists, however, and as members of this American Fisheries Society, should we not consider whether in this wholesale diversion of large quantities of water for irrigation, there exists no menace to the cause of fish culture; if such would appear to be the case, whether these unfavorable conditions are permanent and enduring or whether they are susceptible of modifications; and finally, whether in the evolution of the science of irrigation from its cruder forms to its more finished state there may not arise some new factor which will bring about a readjustment of conditions on a more favorable basis?

Our early irrigation, like that of the ancients, was largely basin irrigation, dependent on floods; available only for a limited time and covering but a restricted area. It was the creation of the more or less primitive conditions then existing. The pioneer settled in the valleys, where by a minimum amount of labor and expense he could irrigate a sufficient area of land to provide food for the family and a limited provender for the family cow and work horses. Other settlers followed, additional small ditches were taken out; the larger co-operative canals followed. Soon all the natural flow during the summer season was appropriated. That thousands upon thousands of trout of all ages, but more especially those of the smaller sizes, were daily being carried into the ditches, only to die upon the fields, scarce occasioned comment.

Meanwhile the hunger for land and the thirst for water continued to grow, until the latter was largely over-appropriated even in favorable years, while in years of drouth many ditches were dry practically the entire season and the rivers themselves became dry beds further and further toward their mountain sources. The harvest of the land was swallowing up the harvest of the waters. Even then there came but a faint warning note from the more far-seeing of those whom we now term "conservationists."

Speaking broadly for the whole inter-mountain country, but more specifically for Colorado, this early irrigation, coupled with the pollution of the mountain streams by mining and lumbering, threatened the complete destruction of the native fishes, as well as fish culture, which was then in its infancy.

No less an authority than Dr. Jordan, after an exhaustive examination during the summer of 1889, summed up the situation as follows:

In the progress of settlement of Colorado, the streams have become more and more largely used for irrigation. Below the mouth of the cañons, dam after dam and ditch after ditch turn off the water. In summer the beds of even large rivers (as the Rio Grande) are left wholly dry, all the water being turned into these ditches. Much of this water is consumed by the arid land and its vegetation; the rest seeps back turbid and yellow into the bed of the river, to be again intercepted as soon as enough has accumulated to be worth taking. In some valleys, as in the San Luis, in the dry season there is scarcely a drop of water in the river bed that has not from one to ten times flowed over some field, while the beds of many considerable streams (Rio la Jara, Alamosa, etc.) are filled with dry clay and dust.

Great numbers of trout, in many cases thousands of them, pass into these irrigation ditches and are left to perish in the fields. The destruction of trout by this agency is far greater than that due to all others combined and it is going on in almost every irrigating ditch in Colorado.

He goes on further to state:

It is not easy to suggest a remedy for it. The valleys in question would be worthless for agriculture were it not for irrigation, and the economic value of the trout is but a trifle as compared with the value of the water privileges. It is apparently impossible to shut out the trout from the ditches by any system of screens. These screens soon become clogged by silt, dead leaves and sage brush, and thus will not admit the passage of the water.

Perhaps most of the trout are lost by entering the ditches in the fall, when running down stream with the cooling of the water. It has been suggested that a law could compel the closing of the ditches after the harvest, allowing the streams to flow freely until March or April. In the fall the water is worth most to the fish and least to the farmers. I am unable to say whether this plan will prove practicable or effective. This is certain, that if the present conditions go on the trout in the lower courses of all the streams will be exterminated and there will be trout only in the mountain lakes and mountain meadows, to which agriculture cannot extend.

More than two decades have now passed. Yet in spite of the admittedly unfavorable conditions, which fully justified Dr. Jordan's gloomy predictions, we find that this irrigated section, and especially the more accessible and better advertised Colorado, is today the angler's paradise. Not only is the native trout still found in abundance, but brook and rainbow trout as well. In fact Colorado and Wyoming's reputations are upheld largely by the magnificent rainbows found in the larger streams. Brook trout have become so plentiful and widely distributed that many people are inclined to think them indigenous.

In the swift, clear, cold waters of the Continental Divide, both the rainbow and brook trout attain a degree of excellence rarely found in their native habitat, even under the most favorable conditions. The fish grow larger, are more vigorous and gamy, while the eggs are more hardy and virile.

That these are not the mere claims of an enthusiast, but are proven facts, is best attested by the heavy demand made on this region by the Bureau of Fisheries for spawn for brood stock at hatcheries all over the country. Indeed, shipments of spawn from these introduced varieties are being made every year, and with splendid success, to foreign countries, as France, Germany, China, Japan and Argentina.

Commissioner Bowers in his report for 1905 states:

> The value of the Bureau's efforts to increase the supply of food and game fishes in the interior waters have been strikingly illustrated in Colorado where a number of non-indigenous trouts have been thoroughly established. The principal fish thus introduced is the eastern brook trout, which is widely distributed in the state and probably exists there in greater abundance than in any other state. Colorado has now become the Bureau's chief source of supply for the eggs of this species, and nowhere else is it possible to collect such large quantities of eggs from wild trout.

You ask me how we can harmonize or explain these existing favorable conditions of trout culture with the unpromising outlook of 1889? In our analysis of this question of the relation of fish culture, or to remain more clearly within the limits of our subject, trout culture, to irrigation, we find two stages of development and growth. The first or basin period had reached its zenith at the period of Dr. Jordan's investigation, while the second or perennial stage was but in its infancy; hence was not recognized as being a possible factor in the future readjustment of fish-cultural problems.

It had early been realized that only a small proportion of the suitable lands could be irrigated from the natural flow from the streams during the summer months. Storage of the flood waters was recognized as the only possible solution of the problem of the utilization of these otherwise valueless acres. Investigation disclosed the fact that away up among the mountains there existed many ideal sites where reservoirs could be constructed at small cost and filled from the melting snow, and where this surplus water could be stored until needed.

Reservoirs of varying sizes were created as though in a night. First came those built by the individual and by local co-operation; then came the larger enterprises financed by outside capital; finally we have the immense enterprises encouraged by state and nation.

Many of these earlier and smaller lakes, as they are frequently called, were promptly stocked with trout. The results already attained have been absolutely incredible and beyond the belief of those who have had no personal experience under similar conditions. I do not propose to weary you by going into detail, but still I cannot refrain from giving you several striking instances which may enable you to realize to some extent the fish-cultural possibilities of these lakes.

Wellington Lake, located on the Colorado & Southern Railway, about twelve miles from Buffalo, Colo., yielded 4,358,000 brook trout eggs during the fall of 1904, while Island Lake, the summer of the same year, produced over 8,000,000 spawn of the native trout.

Perhaps the most striking illustration, however, is in the case of Ragan Lake, located some twenty-five miles from Creede. This is a rather shallow body of water containing approximately seventy acres and is operated by Mr. B. C. Hosselkus as a commercial enterprise. During the latter part of February, 1906, Mr. Hosselkus received from the Leadville station of the U. S. Bureau of Fisheries 100,000 eyed brook trout eggs in exchange for rainbow spawn. These were shipped to Creede over the Rio Grande and arrived in the midst of a severe blizzard. When the storm had ceased, the trays were transferred from the heavier shipping cases to light wooden boxes, such as are used by the oil companies for the shipment of two square five gallon cans. They were then placed on a pack horse and started up the mountain over the unbroken trail.

On several occasions the pack animal lost her footing and fell, rolling down the mountain, but the heavy soft snow prevented any material injury to horse or trout spawn. To prevent freezing, one night the eggs were wrapped in blankets and kept in a ranchman's cellar; the next night they were carefully covered and set by the kitchen fire. The third day they reached their destination and were placed in Mr. Hosselkus' hatchery, where they commenced to hatch almost immediately. The resulting fry were held in troughs and fed until the first of May, when they were planted in the lake as no. 1 fingerlings.

With the cold mountain water at Leadville we rarely hatched our brook trout in less than six months. This was advisable because the mountain streams were not ready to receive fish until June or July.

Early in October, 1907, seventeen months later, on Mr. Hosselkus' invitation, I visited the lake. The trout were just commencing to come into the shallow water. The first evening I tried to amuse myself with fly fishing. The catch at each cast was limited only by the number of hooks. Releasing two and three fish after each cast soon grew monotonous, and I gave it up, voting it butchery rather than sport.

Mr. Hosselkus had meanwhile set two small gill-nets in deep water with a view of catching some large rainbows, the remnant of a small plant made several years earlier. None being taken then or thereafter, he concluded they had either been caught or had died during the previous winter. The nets, however, were literally full the next morning of ten-inch brook trout, which averaged one-half pound dressed. The females were full of spawn, almost ready for extrusion. The latter part of the month and the first half of November, Mr. Hosselkus filled his own hatchery, shipped large quantities to the Denver hatchery of the Colorado Commission, besides sending upwards of three millions to the Leadville hatchery to be eyed on shares. Owing to insufficient help and inadequate facilities the full amount of spawn available could not be taken, though the harvest exceeded ten millions! Is it not truly incredible?

The factor then which has prevented the threatened annihilation of the trout in the inter-mountain country, has been the multiplication of these mountain reservoirs, and not alone through the number of fish actually propagated in them, but more through the large supplies of spawn obtained from them to fill private, state and national hatcheries, later to enter into the general distribution. In addition, I might mention that the filling of these reservoirs during the spring months tends to lessen the flood conditions at that time, while the turning into the streams during the summer months of this stored water preserves a more equal stage during the angling season. The fishing is further improved by the escape from the reservoirs of a large number of matured trout which pass out through the headgates with the water.

Summing up the situation and applying this analysis to the query propounded: We find that irrigation in the earlier stages and under primitive methods is decidedly detrimental to trout culture, though some of the more injurious features are susceptible of improvement. In the more advanced or perennial stage, with the numerous large and small reservoirs storing the flood waters and releasing them as required, we are glad to be able to reverse the verdict and find that irrigation is not detrimental to trout culture. In fact when these reservoirs are utilized as great fish-cultural preserves, then irrigation becomes a most important factor in the upbuilding of fish culture and the improvement of angling in the inter-mountain country.

Irrigation and fish culture have long been considered as being antagonistic; the growth of the one was supposed to mean the decline of the other. My personal observation disproves this, hence I am only too glad to sound an optimistic note and declare to you that these interests are harmonious though not always identical. The present marvellous development of irrigational projects in the west therefore becomes an occasion for sincere congratulation from fish culturist and angler, as well as to our more prosaic brethren who till the soil, since it carries with it wonderful possibilities for fish-cultural expansion.

In recent years, we have heard much of "conservation" and "reclamation." Great as are these themes and fraught with magnificent possibilities for the betterment of humanity, they are incomplete of themselves and fall far short of yielding the greatest possible returns, until the cause of "fish culture" is inseparably associated with them. Conservation has had her Pinchot, reclamation her Carey. Who will rise up and champion the cause of irrigational fish culture?

DISCUSSION

Mr. Thompson: This is to some extent a new subject, particularly so to many of the members of the Society now before me who have never had the opportunity and privilege of working in the irrigation regions, and who, therefore, are not as familiar with the matter as I would like. Hence a full and free discussion, which I urgently solicit, will be especially helpful to us all.

Prof. L. L. Dyche, Pratt, Kan.: I understood the gentleman to say that it was not possible to regulate the outgoing of fish into these irrigation ditches by the use of wire screen nets. Is that right?

Mr. W. T. Thompson, Fairport, Iowa: That was Dr. Jordan's statement, and I endorse it as correct.

Professor Dyche: I do not know just what your conditions are, but I do not have any difficulty in managing fish with wire screens. All the ponds in the new fish hatchery for Kansas will be connected by water-ways that are two feet nine inches wide, and we expect to manage the fish, keeping them out or letting them go into certain places, by wire screens. These screens are made in sections, some 500 of them in all. Those with 3-inch mesh wire are used to keep out coarse stuff, as weeds, brush, moss and wood. Other screens are used as conditions may demand and are made of one-inch, one-half-inch or one-quarter-inch mesh wire. One or more of the screens may be used at the same time. If small fish are to be controlled the mesh may be as small as that used in window screens. We have experimented some, and have had no trouble in keeping out trash, weeds and grass by regulating it with different sized screens. One of the men who has charge of the hatchery grounds goes around, lifts screens and takes out trash; and we do not understand why you cannot keep trash out of irrigating ditches if you will build a cement structure in which the screens of different sized mesh can be fitted, and thus control both trash and fish in the ditches. I do not see why both fish and trash cannot be managed if you put in proper screens. Such a system may need a little care, but it seems to me that it can be successfully operated.

Mr. Thompson: Where was it you were making these experiments?

Professor Dyche: In Kansas. I have a paper bearing on the subject and I will present the matter later in my paper, with accompanying blueprints.

Mr. Thompson: What is the size of your pipe?

Professor Dyche: It is 21-inch pipe carrying 3½ million gallons of water per day.

Mr. Thompson: People have a wrong conception of what irrigating ditches mean. They are of all sizes, but the main canals are really small rivers.

Professor Dyche: We have a river big enough to run a flouring mill which we expect to control through the use of wire screens.

Mr. Thompson: Then again the irrigationist is not necessarily interested in the fish-cultural problem, and you have not only sage brush and silt, but sometimes young trees floating down the streams, which would soon clog the screens since there is no provision made for keeping them clean. Of course this is one of the problems we must solve. A revolving paddle wheel is one of the devices now being tested, but it does not absolutely keep all the fish from entering the ditches. It revolves through the force of the current, causing more or less disturbance of the water, the idea being that it frightens most of the fish back. As a matter of fact, while some of them escape into the ditches and are eventually lost, a majority are preserved. This device permits the passage of debris of almost any reasonable size. Most of this irrigation water comes tumbling down from away up in the mountains, carrying all sorts of debris; it would fill up any ordinary screen so quickly you would scarcely know what happened. The ditch riders and the water superintendents have a very large area to cover and frequently are not particularly interested in fish culture, hence do not want to be hampered by any system of screens. Thus far no system of screens has been a success and we are not disposed to blame them for their indifference. The water-user does not care to incur any extra expense. Here, then, is a problem which should properly be taken up by fish culturists and angling associations co-operating with the Water Commissioners and other proper state officials. Fish culturists have long endeavored to bring about a sentiment in favor of providing some device.

Several years ago while in Colorado I took up this matter of a campaign of education. The state of Colorado in the blank applications for fish inquired whether the headgates of all the ditches were provided with screens or other devices for preventing the escape of the fish. That was educational, because they could not well refuse to give people fish even if the ditches leading from the streams were not so protected. I suggested to the Washington office that the Bureau of Fisheries take cognizance of the irrigation work, and also insert in its blank applications this same, or a similar, inquiry. This was subsequently done. We hope to work up a sentiment which will eventually bring about some system of screens or paddle wheels that is both practical and effective. As yet, however, such a system has not been perfected.

Professor Dyche: You answered the question when you first started out by saying they had no interest in the business and did not care much about it. Of course if you have a big stream with logs running down, provision would have to be made accordingly; but moss, sage brush and sticks I think could be handled with ordinary screens.

Mr. Thompson: It is a problem which has been up before a number of our states in the Rocky Mountain country and in California, especially. Simple as it may seem in theory, in practice it has been found most perplexing.

Dr. H. B. Ward, Urbana, Ill.: Mr. President, I listened to the reading of the paper with a great deal of interest, because I have just returned from a 3 weeks' fishing trip in the San Luis valley, of which something was said, and while there I had the good fortune to come in contact with the places to which reference was made, and also with a number of persons in various walks of life representing different interests, so that I had some opportunity to get the point of view of different classes of persons on this question.

I am very glad to know from so careful a source that the changes in methods of irrigation have been advantageous to the propagation of our mountain trout. On the other hand, I cannot fully agree with the speaker that the situation is quite what it ought to be; and it seems to me that he gives away the secret of the whole matter in saying that those who are conducting the operations in connection with irrigation, do not want to bother with this problem. I think we have passed the time when any class of people has the right to say that it does not want to bother with a problem concerning the conservation of our natural resources; and I submit to this body, when from the irrigating ditches of the San Luis valley, trout, small trout, fair sized trout, to the extent, not of bushes or barrels, but to the extent of wagonloads, are shoveled out from those ditches in the fall, that the state of Colorado is not doing its duty at some point or other. It may be difficult to place the responsibility, though some persons might try to do it. It may be difficult to find the precise remedy, but a loss of that magnitude, the destruction of valuable fish represented by any such quantity, indicates a failure to safeguard the interests of that community, for which somebody or some class of persons is responsible; and I feel very strongly that we should not be doing our full duty if we failed to call attention to the problem very forcibly.

In talking with the citizens of that valley, I remember very distinctly the remarks that were made by some persons there which confirmed the statements of the author of this paper. One gentleman, a physician of education and standing, said to me that there was a device which was reasonably successful in keeping trout out of the ditches, referring to the paddle wheel device which has been mentioned; but that the people who owned and controlled the ditches did not want to bother with it, and that thus far the state had not compelled them to do anything.

Now, the state of Colorado is putting a great deal of money into hatching brook and other trout. Why, may I ask, are these fish permitted to run out into irrigating ditches to be shoveled into wagons and used for fertilizer on the fields? It does not look like a good business proposition and does not look like what I should call modern methods for the conservation of these resources of the state.

I do not doubt that the parties in charge of irrigation projects will not spend any more money than they have to. I do not doubt that they will not find appliances, which are somewhat expensive, successful, until they are forced to put them in; and you could find parallel cases in other parts of the United States and in other lines of fish work, to say nothing of other types of work of an entirely different character.

It may be that the present method of irrigation and the establishment of great basins for the storage of water gives place for the hatching and development of a large number of fish that would not have existed under former conditions; but after all the real question comes back to us, whether through irrigation an unnecessary number of valuable fish are not lost to the community, and I am frank to confess, after having seen this region and having heard at first hand regarding the losses, that I cannot doubt that they reach a large figure, and that some way or other means ought to be taken to protect the state against that loss.

MR. THOMPSON: I am very glad that Dr. Ward happened to be here and had his finger on the pulse of Colorado with respect to the fish-cultural problem. Everything he has said meets with my hearty approval. I do not mean to be understood as saying that all the conditions in Colorado are what they should be; but I do claim that under existing conditions there has been a very marked improvement in the number of trout and in the quality of the angling in Colorado, considering the large increase in the number of anglers. Such being the fact; when public sentiment is properly educated, when the state authorities wake up to their responsibilities and prevent this wanton waste and slaughter of millions and millions of trout, Colorado will come into her own, and not only Colorado, but her sister states as well. I speak of Colorado, because the conditions there are better known, there is more irrigation, there is more fish culture and angling. When these great reservoirs, including the large state and national projects, are completed and properly utilized in a fish cultural way, and when, in addition, suitable protection is afforded our fish, which at present is not the case, then will Colorado and the whole Continental Divide country become in truth the playground of America.

I received a number of letters, shortly before I came here, from the passenger agents of the various railroads in Colorado, which I was anxious to include in my paper, but condensing as much as I could, I found their inclusion impracticable. Each one states that the angling industry is one of the big assets of their respective roads, and that it is increasing in value year by year. I know through personal experience that they are anxious to do all they can to assist in the work of propagation and protection. No one knows better than the passenger agent just what this travel means, nor is any one more apt to be moved by mercenary motives. Hence when I state that the railroads are furnishing the state and national commissions with every facility needed for their work of propagation and distribution it is not only a tribute to the work of the state and national commissions, but a practical recognition of angling as an unquestioned source of revenue as well. The railroads in Colorado furnish the government with probably from 10 to 15 special cars a year for the transportation of government fish, besides furnishing transportation for messengers in the baggage cars. I think you may safely say their contribution to the cause of fish culture is almost equal to that of the state and the nation for the work in Colorado. This would not be the case excepting it had been proved that it yields them immense returns.

Now I brought this matter up largely that the Society might understand the conditions, and possibly voice a note of warning to the states and to the United States.

I visited one of the United States reclamation projects out in Nevada several years ago; it was on the Truckee River, one of the finest fishing streams in the country. I found that, in connection with the Carson-Truckee project, the river had been dammed, and with absolutely no provision in the original construction for the passage of fish. The investigations made at the time were brought about by telegraphic requests of the Nevada Fish and Game Protective Association to their senators, asking that the Bureau investigate conditions. They claimed that there were thousands of pounds of trout being taken daily out of the Truckee River just below the dam. Owing to the execrable fish laws of the state of Nevada, the pot fishermen were allowed to fish right in the midst of the spawning season, and were taking out 10,000 or 12,000 pounds of trout a week.

I investigated and found that one party of four on the first day the season was open had taken from a small fishing area just below this Truckee-Carson dam 1,060 pounds of fish! I verified this statement by going to the market man to whom they were shipped. This is a specimen of the abuses of irrigation. I wish to state that the government promptly provided a fishway in this dam at Derby, Nev. It is my understanding that in the later irrigation projects they have also provided fishways.

FRESH-WATER ANGLING GROUNDS FOR THE STRIPED BASS

By S. G. Worth

In the lines following I set forth certain known fresh water localities where striped bass take the hook and sufficiently describe the character of such river areas as to point to similar grounds in intermediate streams where sport of the kind may have not yet become known. In order to give a practical value to the data I present the names of individuals as well as those of towns, and also the railroad crossings and routes, but without purposing in anywise the advertising of such individuals as guides or any of their wares. If my contribution is to serve a really useful purpose it must contain enough of such detail as to permit the seeker to correspond with or otherwise get in contact with parties on the scene, as those mentioned, the postmasters or railroad agents of the locality in view. As a matter of fact I do not know that even one of the persons named can be reached by letter or continues to reside in the same place.. It is hoped that by pursuing this course a means will be afforded to others interested in gaining access to grounds through their own efforts, and at the right time of year and when water conditions are favorable.

The striped bass follows the run of herrings up the fresh water rivers, and spawns in water temperature 60° to 76° F., but mostly between 65° and 73°, and apparently the taking of the hook is to be expected only after their eggs have been deposited.

The numbers of striped bass vary greatly in different streams and their abundance or comparative scarcity is a factor, of course, in net or other kind of fishing. In the last 15 years the statistical tables of the Bureau of Fisheries and the Census Bureau throw much valuable light on the distribution of the commercial catch.

KNOWN GROUNDS

South River, North Carolina.—As early as 1875 I became aware of the capture of at least one fine striped bass—12 to 14 pounds—in South River near Hawes' Bluff, a point not on the map but on the Bladen and Pender County lines about due east of Kelly, a Cape Fear River landing in the former county. A local fisherman took the fish on a third day's trial and somewhat unexpectedly, as on the first two days his bait and hooks had been taken off with suddenness and so devoid of spring in the fishing line as to practically convince him that he had fouled the tackle on a sunken log. When he dropped his hook at the same spot in the same deep cove—a point he passed in going to and from the chosen black bass and crappie grounds—it was more an act of curiosity than expectation. To his amazement the hook was seized by a striped bass of such strength and size as to put him to his best effort to draw it into his skiff, and in the fish's jaws he found both his recently lost hooks and other hooks whose original owner could not be guessed.

This capture took place at a point 40 to 50 miles above the confluence of South River (there called Black River) with the Cape Fear, a stretch of down-flowing stream that is unaffected by the lunar tides more or less prevailing in the last named river up to the point of confluence.

Neuse River.—In 1877, having business at New Bern, N. C., I learned that hook and line capture of striped bass, a mile or two below the town and the confluence of the Neuse and Trent Rivers, was not uncommon but there were secrets or difficulties attending it that prevented general participation. One of the difficulties was the current belief that no bait was successful except fresh herring roe, an article denied except in the spring months and difficult to keep on the hook when had. It was understood that fishing on those grounds was by hand line. This point was not many miles above brackish water and in some years when the fall months were dry brackish water invaded the grounds where the striped bass were fished for. Now that the Inland Waterway has been opened up from Beaufort or Old Topsail Inlet to the Neuse River, it is learned that the sea water is denser and advances yet higher up the Neuse River.

Roanoke River.—In the years 1879, 1883, 1884, and 1903 to 1909 inclusive, at Weldon, situated at the foot of the great rapids of Roanoke River—the most notable striped bass stream in North Carolina—I found scarcely an exception to the accepted belief that the striped bass would not bite a hook in that vicinity. The reason may be that this is a spawning ground, probably the foremost known spawning ground of the species. In the summer of 1904, however, I learned that fish were being caught on trot lines at a point some miles below and in surprising quantity. On June 7 of that year, my son, Henry B. Worth, in charge of a power boat which I was sending down the river to go into repairs at the Elizabeth City marine railway, stopped in somewhere about the Hobgood Post Office landing to take on water, this landing being not far from the Atlantic Coast Line Railroad crossing on the Rocky Mount and Norfolk branch. There he met a Mr. J. D. Savage who was then fishing with trot lines and by whom he was informed that at a point 1½ miles above Hamilton two men in ordinary seasons would take about 200 pounds a day or approximately 1,000 pounds a week, employing fresh herring (alewife) bait. The last named town is perhaps 25 miles below Hobgood. Evidently the use of the hook was not entirely new in that region. It is also evident that a large angling resource awaits up-to-date single hook methods, the latter apparently not yet known there.

In 1905 a report reached me at Weldon through lawyers or others recently attending court down about the town of Scotland Neck that some hundreds of pounds of striped bass were being caught daily at some point near the last named town on trot lines, and closely following that report was another to the effect that similar captures were being made at the old, historic town of Halifax, situated but 8 miles below Weldon. Immediately, May 20, I proceeded to Halifax and found the report as to that town true. I met the parties who owned the outfits and made the catches and talked with each one and also other residents.

Mr. George H. Stevenson informed me that during 7 days, April 28 to May 5, just prior to a freshet, five skiffs that were operated with skim nets, locally designated "drag nets," for the capture of striped bass had incidentally taken 100 to 200 herring (alewives) per day, the heads of which were used as bait on three trot lines owned by himself, George S. Robinson and John Boyd, the colored public ferryman. The lines contained 50 to 250 hooks each and were stretched across the river, which has a width of perhaps 400 to 500 feet at Halifax, the hooks being 3 to 4 feet apart. With no other bait than the fish heads more than 600 pounds of striped bass were caught, sometimes 20 per day of sizes varying from 8 to 16 pounds, or double the amount taken in the drift nets. The river water was on the clear order but not to say transparent. The hooks were arranged as near as possible within six inches of the river bottom in a depth of from 15 to 25 feet. When the water became muddy the nets would catch more and the lines less. Not a hook was touched when the water became muddy. Though it was the spawning season no ripe fish were taken.

It was found that iced herring (shipped in) was of no value as bait and that the local catch of herring was unavailable as bait except when fresh. The herring captured locally commanded too high a price to warrant the experiment of employing the whole fish, which was bringing 10c. a pound after the heads were removed.

John Boyd had on April 26 caught 3 herring in a skim net, and with the heads he had caught on his 50-hook trot line 6 striped bass of sizes mentioned above. On April 24 he caught on the same line 16 additional ones that weighed from 6 to 12 pounds each.

Mr. Robinson had for many years operated fyke nets in this vicinity and now owned and fished as many as 47. He said that at Halifax the fish would continue to bite till the end of May, water conditions being right. This was the second year of trot line trials at this high-up river point. He had known two men at Hill's Ferry, 20 to 30 miles down stream, to take on trot lines in one night the preceding season 2 large sacks of striped bass or as many as 5 bushels, and he had also known 1,005 pounds taken in 2 nights and 1 day at the same place by 2 men in 1903. Another citizen, a Mr. Hale, informed me that he had known 300 to 400 pounds to be taken on lines at Plymouth in a single day.

From the foregoing it appears that the Roanoke angling possibilities are great when the area of the stream is considered, the distance from Halifax to Plymouth being approximately 125 miles, while the distance between Hobgood and the river mouth at Albemarle Sound is in itself many miles. From the information gained I infer that the best part of the river, when length of season is considered, is from Hobgood to Plymouth or perhaps to the very mouth of the river.

It may be remarked that but for the immense stretch of nets in the water below, operated for shad, herring and striped bass, the Roanoke River would attain renown in striped bass production. That but a fractional part of the run enters that river compared with the number that would naturally ascend, I have all proof that I desire. Anyone who will take the pains to ascertain the times that were so phenomenal in rockfish or striped bass capture at Weldon and vicinity, when hundreds of visitors poured in from surrounding counties to fish and make purchases of fish and join in the great festal event of the year, with their teams of all descriptions and camping outfits, will discover that it was not an event of a hundred or two hundred years ago, but of the closing years of the war and just after, 1864–1867, when the nets and seines in the wide waters below were out of commission as a result of the presence of Federal gunboats which then cut off the fishing and left it crippled for a time after peace was restored.

Before passing on to another stream it should be stated that the striped bass of monster size avoid the trot line devices. At Halifax, for example, as many as 6 fish of average weight of 50 pounds were taken by the netters in just one morning in the year 1903, suggesting what great numbers escape the trot line fishermen and ascend the stream.

Susquehanna River.—It is on the Susquehanna River that enlightenment is afforded regarding the capture of striped bass on hook and line in waters above tide. Those grounds are but a few miles from the broad waters of Chesapeake Bay, but the water is perfectly fresh. The whole stream above Port Deposit, Md., may be considered as rapids, but at Octoraro Junction, as elsewhere all the way along for many miles, there are many pools in which the flow is quite slow at clear river stages or in the absence of freshets. Evidently these rapids are a natural spawning ground of the striped bass and both the shad and herring (alewives) ascend them, both species being caught by Mr. F. W. Irwin, of Octoraro Junction (P. O. Rowlandville), Md., and other seiners.

I visited this locality in August, 1904, and again in June, 1905, was there and spent several weeks with the angling activities under observation. Twenty New York and other clubmen would be there at a time engaged in angling, paying $2.00 a day for board and $3.00 for a boat and guide, besides $1.50 per hundred for bloodworms which were used on the hooks of the spoon troll.

The season opened June 1 and continued some months, to be interrupted only by periods of too clear or too muddy water. Octoraro Junction is a Pennsylvania Railroad station and telegraph office and the anglers were usually told by wire when the conditions were favorable. Some of the anglers were prodigal in the use of the bloodworms, impaling all the hooks would hold. It is understood that while the bloodworm bait was everything that could be desired as an adjunct to the troll, the biting ceased immediately when the common red or angleworm was substituted. These worms were obtained from A. H. Dirkes, 50th Street and 9th Avenue, New York, and arrived by mail or express. The worms are said to be the larvæ of a species of *Chirosomus*, *C. plumosus*. They resemble the common angleworm in shape, color and size.

I was interested to see that the bloodworms buried their heads and also perhaps 25 per cent of the fore end of the body within themselves, in the manner of hosiery turned in and in most handy shape to put on. It was not a turning inside out but, rather, an introverting of the head and fore part of body into the middle body cavity. When received and not at once taken into the fishing skiffs or when kept over night the worms were put in a cavity a foot perhaps below the ground surface and protected with a covering of lumber and earth for preserving darkness, even temperature and moisture. These worms were all reputed to come from New Jersey salt water marshes.

All the anglers—one to a boat—payed out about 70 feet of line and fished over the stern, both angler and oarsman guide facing astern. The catches were fine, early morning and late evening hours, and although none of the mammoth fish were among the number the take of single skiffs not infrequently ran 100 to 200 pounds in one day. The catches were especially good and quickly accomplished when some large tree found lodgment in a pool of right depth.

Other probable grounds.—In all striped bass streams under my observation the species ascends in the spring months close behind the big run of herring (late April) and always to such points in the stream as present a stony bottom. Even in so diminutive a stream as Little River, South Carolina, the dividing line of the two Carolinas on the sea coast, and where the body of fresh water is only about a mile long, the species finds the hard bottom of coquina or phosphate rock. And I may here remark that it was while on this stream I heard a native say that the species invariably seeks such bottoms for the deposition of eggs and from this habit took its southern name "rockfish."

White Oak River.—While at Swansboro, Onslow County, in 1904, I learned enough of the size and numbers of the striped bass run in White Oak River, North Carolina, to suggest hook fishing in its waters. It empties into Bogue Sound at this point and is of stony bottom up toward the Atlantic Coast Line Railroad crossing near Maysville. I believe that it is open for skiffs from the crossing to the salt-water sound. The mouth of this stream can be reached with comparative ease from Beaufort or Morehead in sail or power boat of 30 inches draught, the distance being approximately 25 miles.

Alligator River.—From large intermittent net captures of fish of noteworthy size in somewhat recent years it appears that Alligator River is another North Carolina stream in which the species under consideration may be found of interest to the angler, a wild, wide-water region with densely wooded and tangled shores most easily reached in chartered boat by way of Elizabeth City. The most satisfactory means I found of getting around in those wide-water sounds was to employ an oyster schooner of 10 to 30 tons and put mattresses in the hold down flat on the sheathing, and where there was ample room to spread out clothing and other articles. It was necessary, however, to take someone along to do cooking, as the captain preferred his own mess to himself, in order to watch and otherwise care for his craft.

About muddy water.—There are no fixed terms for expressing the degree of muddiness of water that will give anything like a correct comprehension, in my knowledge, except those employed in the District of Columbia. On examining the local columns of Washington newspapers it will be seen that a daily report from the Great Falls is made of the temperature and condition of the Potomac River and the *condition* is always given in numerals, as 1, or 4 or 10, etc., these numerals indicating, as I understand, such number of inches as an object may be discerned in the water through the side of a clean glass vessel with a straight side. I was informed in fact that the data were obtained and published largely, or perhaps solely for the benefit of anglers—to let them plan fishing trips to the best advantage with reference to catch and the saving of time.

River accommodations.—It should be said that on all the streams mentioned except the one in Maryland it would be necessary to provide a tent and commissary outfit in order to get and remain in touch with rivermen from whom much certainly would have to be learned in new territory, there being practically no accommodations near enough the fishing grounds to be made available. All of the localities named are mosquito ridden and I would not for a moment consider going into camp in such places without advance preparation in the way of large nets containing 20 square yards of cheese cloth each.

DISCUSSION

Mr. D. B. Fearing, Newport, R. I.: I am very much interested in Mr. Worth's paper. Some 45 years ago, when I was seven years old, I lost my first striped bass, and I have fished for striped bass in many places since that time.

I was very much interested in what Mr. Gorham said about fishing in brackish water. I remember when a small boy going to a certain river in Rhode Island and seeing my father catch a striped bass with a fly, and I have records of the capture of striped bass in Great South Bay, Long Island, with the yellow sally and red ipis and the white miller; but the fishing in brackish water as an angler's pastime has all been transferred to the Pacific Coast. On the Atlantic Coast and in the east where I come from, I can remember as a boy at the West Island Club when it was a common thing for an angler to land 60 to 70 striped bass with rod and line in a day's fishing, fish that would run anywhere from 6 to 64 pounds; and as late as 20 years ago I saw 20 to 30 fish landed in one catch. At the present time you could fish from daylight till dark and never get a striped bass. There are gill nets that stretch from one to three miles in length straight out, and where there are no gill nets there are purse seines and pound nets. The striped bass in cruising around will strike one of the gill nets, but they will not go into them, turning instead and going straight out to sea. There is no angling for striped bass except after a storm which carries away the nets, and then good big striped bass are caught. But the old days when you could catch them with rod and reel are gone.

In California I have had many communications from the President of the San Francisco Anglers' Club, who was very much interested in the introduction of the bass out there, and in the fishing. Mr. Worth says they use herring for bait, but he writes that they find the best bait for striped bass out there to be the large clam, and when they cannot get this particular Pacific clam they troll for the bass with a spoon; and they claim that they will bite one curiously shaped spoon and will not look at another. Personally, I think the striped bass is a most extraordinary fish, as to what he will take. I have caught striped bass with pretty much everything, even with a finger-stall. I caught one that looked so fat that we cut him open on the rock and he had 5 or 6 menhaden heads in him, and mussels and all sorts of things, together with the stall that had been around a fisherman's finger to protect a cut. I had this stall tied on my hook and caught a bass with it.

If we could only persuade the legislators of the various states to pass a law forbidding the killing of bass on their spawning grounds, it would be a most excellent thing. You go into the New York and Washington markets and you will see cow bass loaded with spawn. You will see in the New York markets today bass offered for sale which are less than six ounces in weight.

The striped bass is a foreign fish to California. It was introduced in 1879 when 135 were turned out; in 1882 a plant of 300 more occurred and the biggest weighed only 8 ounces. In 1902 1,200,000 pounds of striped bass were sold in the San Francisco markets alone. It is the most successful introduction of a foreign fish that has ever been known. The people of California have protected their bass; they have a closed season for the bass during the spawning season, and it is against the law to take a bass under a certain size. On our coast we do that after the fish are all gone and there are none to protect.

Mr. Meehan: Like Mr. Fearing I am a great friend of the striped bass and very fond of angling for them. It may interest some to know that I was probably one of the first half dozen persons to use the bloodworm for bait in the Susquehanna River. The first man to use it was Mr. Dercks, the gentleman mentioned in Mr. Worth's paper. Prior to that time clams and crabs had been used to catch the striped bass in the Susquehanna. A week after Mr. Dercks was there another man came from New York and fished, and I happened to see him going home. He had quite a bunch of bass and told me about the bait. We secured the bloodworms and used them with great success. In the first trip two of us caught in the neighborhood of 350 pounds in a trifle over a day's fishing, the average run of the fish being from 3 to 9 pounds. The heaviest bass that I caught myself was 15 pounds, and generally I would average one or two, possibly three, 12-pound fish in the months of July and September. It was pretty nearly a rule for men fishing there afterward to throw back everything under three pounds. The bloodworm was used in connection with a small trolling spoon, about a no. 4, and casting became quite prevalent there, especially in the evenings, from the rocks above the station and on the Harford County side, on the right bank where most of the pools were.

Another fishing ground where striped bass are caught in some numbers is in the Delaware River above Trenton in the neighborhood of Scudder's Falls, Washington's Landing, and up as far as Lambertville, but the striped bass caught there are usually very small, rarely exceeding 3½ to 4 pounds, although once in a while a fish weighing 12 to 15 pounds is taken. Bloodworms are used there.

In respect to the protective laws, the state of Pennsylvania classes the fish as a food fish and allows them to be caught with a rod and line throughout the year; but has a closed season so far as net fishing is concerned. Pennsylvania and New Jersey having concurrent jurisdiction over the Delaware River, combined and enacted a law which prohibits the catching of striped bass less than 12 inches in length, or more than 20 pounds in weight. Any striped bass over 20 pounds in weight caught in the Delaware River must be returned. That is on account of the Salem County end of New Jersey, where the large bass come in to spawn, and they are not caught for the purpose of permitting propagation.

Mr. Fearing: I would add that the only bloodworm fishing that I know of around New York is on Long Island, although there are a number of New York anglers that make bluffs at it. But the South Side Sportsmen's Club on Long Island, at Oakdale, 10 years ago started in and found that striped bass could be caught with bloodworms, and now it is their greatest sport. They have a protected private series of trout ponds. There are about 110 members in the club; and they are only allowed to catch 15 fish a day. The fish are all liver-fed and will bite at anything, and there is no sport in it. In the striped bass fishing they are limited to 16. I forget how many years ago it was that they caught some 1,800 striped bass; and the biggest one ran 12½ pounds: 7½-pound fish are caught with bloodworms and a small spoon, with a four-ounce trout rod; and it is the finest sport, I think, there is on Long Island.

Mr. G. H. Graham, Springfield, Mass.: I would like to inquire if they have ever fished with bloodworms for other fish besides striped bass.

Mr. Fearing: They never have. I never used bloodworms as bait for anything except striped bass.

Mr. Graham: Why would it not be all right for black bass or salmon?

Mr. Fearing: I think the bait is first class for black bass, but it is not always very easy to get bloodworms.

Mr. Worth: I have understood that this worm constitutes a considerable part of the diet of the striped bass when it is down in brackish waters in winter time—a natural food in the salt water. I was informed that it was impossible to fool a striped bass by using the common angleworm; that it could not be done; they would not bite an angleworm at all.

Mr. Fearing: I have tried it and they will not take an angleworm.

Mr. Meehan: On the Susquehanna River at Octoraro there are grounds famous for black bass and pike-perch. The latter species is known there as the Susquehanna salmon. On one occasion I saw a pike-perch weighing about five pounds that was caught by a fisherman while trolling with bloodworms; but I never saw or heard of a black bass being caught in those pools with bloodworms; although I did hear of a few that were caught by using just a single bloodworm. You see at that point they use, as Mr. Worth has said, quite a bunch of worms, seldom less than three or four. The worms are usually strung on two hooks, one placed above the other, and they hang from one hook to the other, making a large bunch, too large for a black bass. The particular pools at Octoraro are famous for pike-perch after the striped bass season is over, which ends in September in that section.

ARE THE HATCHERIES ON THE GREAT LAKES OF BENEFIT TO THE COMMERCIAL FISHERMEN?

By S. W. Downing

We have often been asked, "Is the propagation of food fishes at the hatcheries really any benefit to the commercial fishermen and the fishing industry generally?" My reply has always been, "I certainly believe it is," and in this paper I will endeavor to prove the assertion.

At all the stations on the Great Lakes which are being operated for the propagation of the fishes most sought after by those who catch fish for market, the supply of eggs for hatching are all obtained from the fish caught for market by the commercial fishermen, the eggs being secured either by having men go out in the boats with the fishermen to strip the ripe fish as they are taken from the nets, or by purchasing the fertilized eggs from the fishermen at a certain price per quart. The number of eggs so secured necessarily depends upon the number of fish taken by the fishermen, and as the number of eggs collected from year to year has steadily increased, it is safe to say that the number of fish caught by the commercial fishermen has increased in like proportion.

To show the increase from year to year in the number of eggs received at the Put-in Bay, Ohio, station, I have formulated the following table, covering a period of twenty years, beginning with the year ending June 30, 1892, and ending with the year ending June 30, 1911, and showing the numbers of all kinds of eggs collected in the different fields operated by the Put-in Bay station:

Year	*Number of Eggs Collected*
1892	192,966,000
1893	83,214,000
1894	258,640,000
1895	518,460,000
1896	189,363,000
1897	96,743,000
1898	361,778,000
1899	678,840,000
1900	492,330,000
1901	636,244,000
1902	773,060,000
1903	485,119,000
1904	533,619,000
1905	816,664,000
1906	695,471,000
1907	1,055,629,000
1908	971,550,000
1909	1,046,646,000
1910	917,558,000
1911	1,115,585,000

The above table shows an increase from 192,966,000 eggs collected in the year 1892, to 1,115,585,000 in the year 1911, or in round numbers six times as many during the last year as during the first year of the table.

In some years the table shows an apparent falling off in the number of eggs collected, but the general tendency throughout the whole period has been upward. The smaller take of eggs could no doubt be accounted for by unfavorable weather just at the time the fish were spawning freely, as a few days at the height of the season often makes a great difference in the number of eggs secured. The falling off in the take of eggs in the years 1896 and 1897, the years showing the fewest eggs taken since the first two years, can be accounted for from the fact that during those two years no pike-perch eggs were collected.

The increase in the number of eggs collected at this station during the past six years would have been much greater except for the fact that during that time the take of eggs from the original territory has been divided with the Ohio State Fish Commission. An agreement being entered into in 1906 whereby the Ohio Commission was to collect the herring eggs and the U. S. Bureau the whitefish and pike-perch eggs, the fields formerly operated by the government station for the collection of herring eggs were turned over to the Ohio people. Their collection of eggs from these fields has been as follows:

Year	*Number of Eggs Collected*
1906	228,640,000
1907	46,440,000
1908	84,470,000
1909	171,164,000
1910	285,960,000
1911	290,456,000

If this take of herring eggs collected from the fields originally operated by the U. S. Bureau be added to those mentioned in the table, a far greater increase would appear. The table shows that the average take of eggs for the first thirteen years, was 407,696,000, while the average total from the same fields during the past seven years, including the herring eggs collected by the Ohio people which rightly belong in these figures, reaches the enormous sum of 1,103,747,000, or a little less than three times as many as the average for the first period of thirteen years.

The greatest increase perhaps has been in the pike-perch work. The writer remembers that before this excellent food fish was propagated at the hatcheries, the catch had fallen off to such an extent that many of the fishermen did not set their nets for the spring catch, as there were not enough pike-perch being taken at that time to warrant putting the nets into the lake for the spring fishing. At the present time the spring fishing for pike-perch is the more profitable of the two seasons.

We believe that the above facts will bear us out when we say there is no doubt whatever but that the propagation of food fishes is of great benefit, not only to the commercial fishermen and dealers, but also to the general public as well.

DISCUSSION

Mr. Meehan: I might say that to those figures should be added an average annual number of between 350,000,000 and 400,000,000 taken by Pennsylvania, which would swell that great total considerably. I do not think New York collected any from Lake Erie, but those figures embrace lake herring and blue pike particularly, and whitefish from eggs taken mostly on the Canadian side, also some few taken in confinement by the fisheries department of Pennsylvania. As a result, the catch has greatly increased. In the Pennsylvania section alone, covering only 45 miles, the industry increased in eight years from a little over $200,000 to $600,000 a year, with a proportionate increase in the number of boats.

It may be said that you may travel anywhere along Lake Erie from one end to the other, and you will hear nothing but exclamations of enthusiasm with regard to the work of the United States and Ohio and Pennsylvania on Lake Erie, and what has been accomplished there. This is very flattering, since it so often happens that commercial men and others look upon the fish culturist and the fish protectionist as their natural enemies.

Mr. W. O. Buck, Neosho, Mo.: One point wherein this paper is especially gratifying is that it shows results from artificial planting of fish. That is to my mind a most important point. Merely working up a record showing that we have collected so many eggs and turned out so many fry looks very well on paper, but it does not amount to anything really, if that is the end of it. When we actually can find that the catch of fish is increasing because of our plants, it is encouraging.

And it is especially so, if results can be shown in the case of pike-perch because of the extreme delicacy of this fish. During the last two years I have handled pike-perch eggs, having had no previous acquaintance with them, and although a fair proportion of living fish have been turned out I have not found great satisfaction with them, because the fry are so delicate that I have feared they would perish soon after being turned out. I am not in position to know whether they did or not. Mr. Downing, being in charge of the collecting work, knows what he is talking about when he says that his work has produced results.

Mr. Meehan: While this Society was in session at Washington in 1908, I received a telegram from the city of Erie, saying that the boats brought in so many herring that the dealers were unable to handle them. Word was sent up town to the people in Erie to come down and take away what they wanted. There was a surplus of 25 tons. That was the beginning of the big jump. The following year the dealers filled their houses very promptly, or nearly so, and they issued orders to the boatmen not to bring any more than an average of three tons of herring per day. They cut out half their nets for several weeks. They did the same thing last year for about a week; so that the increase was very marked in the catch.

Mr. Downing: I would like to cite one other instance where it is proven that the planting of fish is a benefit.

One season while I was in charge of the Alpena, Mich., station, I collected pike-perch eggs at Saginaw Bay. A part of the fry resulting from these eggs were returned to the waters of Saginaw Bay, and the balance were planted in Thunder Bay about twelve miles out from Alpena. I was soon sent away from Alpena, and about four years after having made the plants in Thunder Bay, I received a letter from a man both a dealer and fisherman, who, while I was at Alpena used to blackguard me a great deal about getting money that I was not earning, as I was in the government employ and having a snap, and asking me what I did with all those millions of fry that I claimed to have hatched.

In the letter, he inquired if I could tell him how he could get some more pike-perch fry planted in Thunder Bay, saying that that year, beginning with the first lift of fish in May, the take of pike-perch in waters where they had not been known before had ranged anywhere from 1,500 pounds to three tons at a lift from 4-pound nets, and continued until November, when he took his nets out.

Mr. Meehan: In 1904 a man at Sunbury on the Susquehanna applied to my department for some pike-perch to be planted in the river. The stock had been distributed, and all that I had then were some blue pike, which were just coming in. I told him that I had no pike-perch or "salmon" as he called them, but did have some blue pike, very much the same, in fact, said by ichthyologists to be the same thing, that I would send him. I sent him a supply which he planted. Three years later I began receiving letters from the neighborhood of Sunbury, from between Sunbury and 15 miles below, asking whether I had heard about anything being wrong with the Susquehanna salmon; the people were beginning to catch quite a number of fish of a peculiar bluish tinge and thought they were totally unlike in color to the "salmon" in the Susquehanna, which were called yellow. They would have thought that the fish were diseased, only they struck the hook and fought as vigorously as did the salmon. Did I know what was the matter!

Blue pike are being caught in considerable numbers from Williamsport down to a short distance above Harrisburg, and it is considered today to be rather more abundant in the Juniata, in the Huntington and Blair County section, than the Susquehanna section itself, where it is today known and called the blue pike as distinguishing it from the Susquehanna salmon.

Dr. Tarleton H. Bean, Albany, N. Y.: New York is not doing as much in the hatching of eggs from Lake Erie fish as it expects to do in the future, because New York has no suitable vessels for egg collecting on that lake. For the past few years small numbers of lake herring and blue pike have been developed at Bemus Point, on Chautauqua Lake, and Caledonia. I need not say to any expert fish culturist that it is pretty difficult to do the work at long range without a suitable collecting vessel. Still, if I remember rightly, the plant last spring from those two stations was not less than 30,000,000 of lake herring and nearly as many blue pike. We are, in fact, just beginning.

Our pike-perch work is done chiefly at Lake Oneida, where we have no difficulty in taking upward of a hundred thousand gravid fish in a season. Last spring, in May, the Oneida hatchery had 1,200 quarts, each quart containing 150,000 eggs; that hatchery was completely filled with pike-perch eggs, and there was a surplus of 300 quarts taken to Caledonia and hatched there.

Naturally we did not deliver all our pike-perch to the Great Lakes. We know that the planting in the inland lakes, small and large, have been extremely successful, and the anglers are delighted with the results obtained from the planting of the pike-perch fry.

Many of our lakes furnish excellent fishing, as, for instance, in Chautauqua, where no pike-perch were ever found before we planted them there. I could name a dozen lakes throughout New York state in all parts of it, east and west, which are now open to the angler.

There is no doubt about the success of planting pike-perch fry or lake herring in the state of New York. We have a substitute for the lake herring and a very good one, too, in the tullibee—a rather small but beautifully-shaped lake herring. It is the same as the tullibee which was originally taken in Onondaga Lake. It has apparently left Onondaga Lake because of the pollution of the water by the manufacturers. Or it may have been a resident of Oneida Lake and was not discovered by the expert fishermen there until recently. We hope next fall to take enough eggs in Oneida Lake near the station to fill the hatching jars.

Mr. Meehan: We have been very successful in Pennsylvania in planting pike-perch fry averaging about three days old, in the smaller lakes of Pennsylvania, which are all very small except two or three, at least they are small compared with the larger inland lakes of New York. But a very remarkable example of the success is shown in Conneaut Lake, the largest lake in Pennsylvania, about four miles long and a mile wide. Pike-perch were planted there in the 80's, and subsequently until about two years ago no one knew how to catch them. It developed that they were there when we set our traps for muskallunge, for the traps were pretty well filled with pike-perch every day. We have taken eggs there for the last two years, obtaining from 4,000,000 to 6,000,000. Last year reports came to me of over 1,500 pike-perch caught with rod and line at Conneaut Lake.

Mr. G. H. Graham, Springfield, Mass.: I would like to ask Dr. Bean if he considers it a good plan to plant pike-perch in lakes in New England that at the present time contain black bass and pickerel?

Dr. Bean: We do it in New York, because the pike-perch, black bass and pickerel are natural associates. You will find them almost everywhere, throughout our state at least, always associated. On the assumption that nature knows best what fish will live together in harmony, we follow nature; but we never plant pike-perch in a lake which contains trout, or any member of the salmon family. We reserve the pike-perch for bass lakes and yellow perch and pickerel lakes.

Mr. Meehan: That is the system with us. We find that the three fish have practically their own domains, the bass being in one, the pickerel in another and the pike-perch in a third. So that they seldom interfere with one another. Occasionally the pickerel and the bass will get into a scrap, in which case the pickerel gets the worst of it; but we have never found that the pike-perch interfered in any way with either the bass or the pickerel. Their habits are to keep close to the bottom and among the rocks and in the deeper water, while the bass are among the rocks, but in the shallower parts of the lake. The pickerel are in the muddier parts of the lake among the weeds and leaves.

Dr. Bean: I might add a word on that subject. The spawning habits are very different for those three fishes. The pickerel runs up into the bogs in a few inches of water, casting its eggs in masses just after the ice leaves, the bass is a nesting fish, and the pike-perch goes up into the little creeks, spawning at the surface naturally, the female fluttering about near the top of the water and attended by four or five males. Again, the eggs are different, very different indeed, in every respect, so that there seems to be a natural provision for associating those fish in the same waters without injury to any.

ATLANTIC SALMON IN FRESH WATER

By Charles G. Atkins

In the fish-cultural work of the Craig Brook station the Atlantic salmon has always been the leading species; and the methods adopted, which have been essentially different from those pursued with any species of salmon elsewhere, have afforded data for some interesting and important biological deductions.

The methods pursued are in outline as follows: Brood fish are secured each year by purchase from the weir fishermen located on the tidal portions of the Penobscot River and are conveyed immediately to a roomy enclosure in a small fresh-water stream. Here they remain without food and without other care than such as is necessary to guard them against escape from the enclosure or destruction by human or other foes, until late in the month of October, when the earliest of their eggs are mature. Artificial work, after the usual methods, relieves them of their eggs. Spawning is nearly always completed before the middle of November, and then the salmon are liberated—commonly in tidal waters.

The collection of brood fish is always made in May and June, and at that early date it is found that the external appearance of the two sexes is so closely alike that it is impossible to distinguish males from females, and they are therefore bought indiscriminately. In September, however, it is found that the sexes have developed peculiar features which afford ready distinction between the sexes. At the spawning season it is always found that there are more females in the enclosure, an extreme instance being the brood of 1910, when out of 693 salmon there were 436 females and 257 males. In some other countries it has been reported that there is a predominance of males.

Early in the history of the station, studies were made on the question of the survival of the salmon that had spawned and their subsequent return to the river. The liberated salmon were marked by metal tags attached by wire to the rear margin of the main dorsal fin. Each tag was stamped with a number which referred to a record of all important facts relative to each fish, so that on recovery of a marked salmon it was possible to follow its history back to the day of its spawning and compare its length, weight, etc., on each occasion. This experiment was carried on for several seasons, and in all over 1,200 salmon were marked. Nearly 40 of these were recovered with the tags on. A few of them were recovered in the spring following their liberation, and the condition of these fish showed that they had been lingering in the river and had taken little or no food. The most of them, however, were retaken during the May and June of the second season following their liberation—that is, two years after their first capture; these salmon had fully recovered from the emaciation of the spawning season, and measurement showed that in each instance there had been an increase in length. Several of these recaptured fish were females and in the autumn gave a second litter of eggs. It is probable that the 40 recaptured fish were only a small portion of the actual survivors out of the 1,200 marked; for it is altogether likely that most of the tags dropped off. Indeed, it seems a wonder that any stayed on, considering the long time that had elapsed and the constant motion to which the tags were subjected, swinging back and forth with every movement of the fish. It being thus established that Atlantic salmon return to the river a second time for procreation, being then 6 years old, it is not improbable that a few of them return again, spawning the third time when 8 years old, and quite possible that in rare instances the process may be repeated a fourth time at the age of 10 years.

It has until recently been supposed that the recovery of a salmon from the exhaustion of the reproductive process required absolutely a return to the sea and a sojourn of some months in its natural element, with access to its natural food. It was therefore without any expectation of a favorable result that the experiment was tried of retaining salmon in fresh-water ponds for several years after their first spawning. In November, 1908, some salmon of both sexes were after spawning transferred to one of the artificial ponds at Craig Brook, and 8 of them were retained for this experiment. Three of these fish died in June, 1909, and one more in September. The remaining four lived through to the spawning season of 1910. For the first 10 or 11 months of their stay in the pond they refused to eat anything, though often offered small herring and other food. In the fall of 1909, however, they began to eat and showed good appetites, eating through the winter. When the spring of 1910 opened they began to eat ravenously and continued to do so until about July 1, when their appetites began to fail, and in a few days they wholly ceased to eat. The food taken had evidently improved their condition, and they came to the spawning season of 1910 in as good condition (excepting one fish) as is usual with salmon that have been confined a single summer. There were found to be two males and two females. On November 2 they were subjected to the usual process of artificial spawning. Both of the males were found to be in normal condition, yielding milt as usual. One of the females was sickly and gave inferior eggs which never hatched. The other female appeared to be in normal condition in every respect; her weight was fully up to the average for salmon of her length (32 inches) and her eggs were of prime quality, for they developed as usual and hatched a normal proportion of fry which have thrived through the first summer fully as well as any others. After spawning, the two males and the best of the females continued to live, ate nothing for several months, recovered their appetites in April and May, eating well until about the middle of July, when they ceased eating, and have continued to abstain from all food until the present writing, September 28, 1911, without showing any unfavorable result.

CONTROLLING THE MOVEMENTS OF FISH

By W. O. Buck

The essentials of fish culture are three: food, water and control. Indeed, since everything alive needs food and water, mention of these might be omitted and the assertion made that the essential of fish culture is control.

We realize the need of regulating water-supply for the purpose of preventing interference, of things animate and inanimate, with our fish from the egg to the adult stage: Attention is invited to the equally urgent need of controlling their movements.

To catch adult fish we study their habits and pit our wits against theirs. Even when we seine them this is partly the case, though it is then more a question of main strength and stupidity, the fish being supposed to furnish the stupidity, although it is to be feared they are not always allowed a monopoly of it. And here is a point at which improvement may be made. Wherever it is at all practicable the fish should be led to go where they are wanted rather than dragged thither.

It is unnecessary to expatiate on the disadvantages of seining fish ponds because that is realized. The suggestion is that we get at some better method, instead of plodding along the same old wrong path. When eggs are hatched in jars the fish swim over of their own accord to the collecting tanks and are held by screens. Most fish culturists will recall the thrill of horror with which they have at some time or other found this literally true; that is, the fish were held by the screens instead of by the tanks. Here we start right by allowing the fish to follow their impulse to go with the current and should go further and hold them where we want them by offering no road out. It is not sufficient to provide the road and blockade it with a screen. The screen being a necessary evil should have as large a surface and as little current as practicable. Where a long trough is used for a collecting tank the screen may be lengthwise instead of crosswise, thus giving vastly more surface and correspondingly less current through it at any point.

Advantage may be taken of other impulses also to keep fish away from the screens. Trout fry shun the light and will seek the middle of the trough if that part is dark. Pike-perch fry are very active from the first and seek the light and may be attracted away from the screens by a bright spot elsewhere. In ponds young bass seek the current and struggle to pass screens and it should be practicable to take advantage of this fact and collect them without need of seining the whole pond or any considerable part of it. By a suitable arrangement of ponds and pools and adjustment of screens of different mesh the young fish might be collected and separated not only from the brood fish but from those of the same season but different size. Fear is a great help to a small fish in the business of getting through a small hole. If desirable to hold young fish in the breeding ponds, it may be best to reduce or cut off the overflow. This is sometimes the only practicable way, since a screen fine enough to stop the smallest fish will be sure to clog and overflow or to catch the young fish attempting to pass it. This point is especially urged. Reduce the inflow until there is little or no overflow.

It may be claimed that the food for the young fish is brought to them in the water-supply and the inference drawn that the greater the flow through the pond the more food there will be in it. If this were true, it evidently would not do to cut off the supply. But it seems reasonably certain that fish food is produced in greatest abundance in quiet, warm water. Within limits such water will answer for young Salmonidæ and it suits bass exactly. A temperature of 70° F. is warm enough for adult trout and salmon, but the young will bear 83° F. Adult bass will seek cooler water when the temperature reaches 90°, but 92° does not appear harmful.

Perhaps insect food does not travel so fast nor so far as we are apt to suppose. Quite possibly these creatures which breed in running water find shelters there and mostly remain in the stream. Probably insect food should be produced where the fish can find it rather than where it must be carried to them either in the water-supply or otherwise. Fortunately in bass culture the conditions which favor the production of insect food suit the young fish also. It may be that a reason for the good results obtained with large ponds for bass is the greater proportion of warm, quiet water existing in such ponds, since it may easily happen that the increase of water-supply is by no means in proportion to the increase of pond surface.

Number and kind of plants, the shape of the pond and configuration and quality of its bottom as well as amount and position of intake and doubtless many other conditions affect results, and it may well be that these varying conditions account for the difference of faith and practice of fish-culturists as illustrated in the fact that some find it necessary to sweep as soon as the young are large enough to be handled while others leave the young in the brood ponds until fall and have good success. Some who leave them till fall mention that the young are all of about one size. This fact would not justify an inference that there had been no cannibalism, but rather suggest that all smaller had been devoured. Sorting is a recognized means for control of cannibalism. But where the young are taken out and placed in a pond by themselves losses continue and to an extent which would be considered ruinous in any other business. An illustration of this is the case mentioned by Mr. Titcomb in his "Aquatic Plants in Pond Culture," of 6,000 fine fingerlings being taken from a pond into which 20,000 fry had been put eight weeks before.

The inference is not far-fetched that the same thing may be true when the young fish are planted. Here, however, there are two things for our encouragement. The fish are supposed to be so placed that they can make their escape by scattering and we may, if we will, help this along by wide planting. Then, too, if we are made that way, we may perhaps believe that young fish do not eat one another after planting because we do not catch them at it. This sort of argument is not wholly satisfactory to some persons, but all too much of fish-cultural practice has nothing more substantial behind it. It is not the present purpose to more than allude to the all-important question of what becomes of planted fish, the problem just now being how to get the greatest number in possession for planting, and two suggestions are offered.

1st. In both tanks and ponds prevent fish from escaping into the current by having no such current within their reach.

2d. As a help in prevention of cannibalism make the fish sort themselves by giving them opportunity to pass screens of various mesh into separate enclosures.

This latter idea has not yet been worked out and put into successful practice although it is not new. The principle is much the same as in Mr. Snyder's screens for sorting trout, except that in these the motive power of fear is applied by moving screens until the fish are crowded, while for bass in ponds pursuit by larger fish would provide the impulse.

In controlling overflow a practical point requiring attention is that of getting flash-boards entirely tight, or substituting something for them which will be tight. Professor Dyche and Mr. Catte use outlet pipes of a U shape, one elbow screwed on practically tight but loose enough to admit of turning. The water-level is determined by the angle at which the elbow is set. Control of the overflow being provided, current and thereby the movements of the fish may be controlled at the intake.

DISCUSSION

PROF. L. L. DYCHE, Pratt, Kan.: Mr. Buck referred to the manner in which we control water through certain pipes at the Kansas state fish hatchery. The method in the old hatchery is not satisfactory, and the new hatchery which we are planning will be under a different method altogether. The water will be allowed to flow from one pond to another through pipes and cement gateways which latter will be two feet nine inches wide; these gateways will have at either end places for putting in flash-boards, and other places for putting in wire screens. The screens will be made of three-inch mesh, half-inch mesh or quarter-inch mesh, and very fine screen mesh, as fine as is necessary, to control the fish or keep them from passing through the screens. This will admit of free passage of the water through these passage-ways from one pond to another, and it will be under control.

In this new hatchery we plan to have all the ponds connected, as indicated above. We like large ponds, but not too large. We like a pond that can be drained easily, and these ponds will be so arranged that each one can be drained independently without any interference with any other pond. Many of them are arranged in pairs, so that when we put breeders in a pond, it will be possible for the younger fish to pass through the gates into the next pond. We plan to have V-shaped screens that will allow the young fish to pass through between the fine wire screens, through a narrow slit, then they can swim about and feed in pond number two and not be able to get back where the old ones are. Experiments have shown that the young fish will hunt a very small outlet. At the Kansas hatchery we discovered that many young fish had passed from a breeding pond to a retaining pond where we did not want them. On examination we found a pipe covered with wire screen. The meshes of the screen were a little coarse, and were large enough to allow the small fish to run through, and thousands of them came through there, though the pipe through which they passed was only three inches in diameter.

The above experience suggested a number of things to us in regard to the moving of fish from a breeding pond into a pond where they could be cared for and handled by themselves without disturbing the old fish and without disturbing the young fish, and it undoubtedly had something to do with the ideas that guided us in the planning of a new hatchery. It furnished an idea of how fish might be handled through the entire system of ponds in the new hatchery, which will embrace more than a hundred in number when completed, and will be so arranged that fish can be moved from one pond to another without handling them. One acre has been adopted as the standard size for ponds, but as a matter of fact the size will vary from one-half to one and a half acres in area. In the system we are trying to develop, any one of these ponds can be drained independently of any other pond, and can be drained, if necessary, in 24 to 36 hours, and can be filled in 24 hours. Any pond can be shut off and the water can be made to flow through other ponds, making it possible to do something with a pond in a very short time, if necessary. This idea will be worked out in the pond system of the new hatchery.

What Mr. Buck referred to had to do with the old hatchery, rather than with the plans that we are developing for the new one.

Mr. Buck: Have you followed your experiment through of holding young bass or trapping them in a V-shaped screen with a small opening between? I tried quite a number of experiments to trap them in that way, and I found they did not pay any particular attention to the fact that the screens were V-shaped. They could as easily go through one way as the other; they could see that way and would go right through. I did not succeed at all in trapping bass with any such arrangement.

Professor Dyche: I do not see how they can get back. They would swim by. I have used the same kind of a device for the trapping of minnows, and it worked successfully.

Mr. Buck: That is the theory, but they did not do it. They went back and forth freely.

Professor Dyche: When the young fish go through the trap gates into the new feeding grounds, they may be shut up there. The trap gates need not be left open except while the fish are going through. The small bass, when they begin to swim about, will go with the water that is going out, and every one that comes along apparently goes out. After they get larger and stronger and, say two-and-a-half inches long, they seem more willing and able to go against the current; however, by this time the passage-way may be closed so that they cannot go back to the breeding pond where the old ones are. Such an arrangement, so far as I have been able to work it out, seems to be a good one. If this system is not altogether satisfactory, the pond system will admit of almost any kind of an arrangement for almost any kind of work that one may want to do. One can connect a number of the ponds or can have them all independent. One can handle the water as one sees fit; the ponds are built small, averaging an acre in size. We will have a hundred ponds, which will give a great deal of perimeter—a vast amount of shallow water, where the proper kind of plants can be grown and where other natural conditions favorable to the fish can be produced. We do not want to interfere with the fish any more than is necessary; we want to let them alone. We hope to provide conditions that will encourage the fish to do just what they want to do, to breed and produce their kind. That is the idea of building ponds having considerable perimeter. These ponds are basin-shaped; and when the water is at its normal stage it will be six feet in depth at the deepest places and the places where the ponds are to be drained.

Mr. G. W. N. Brown, Homer, Minn.: At the Homer station, the outlet or drain boxes are provided with a cement partition, which affords perfect water control. Suitable openings are provided at a proper height to allow the overflow to pass out when the pond is filled, also for maintaining different water levels desired or for drawing down the pond. A recess in the front side of the partition is provided to admit a board, in sections, for closing the openings, thus effectually preventing leakage. This method is recommended where it is necessary to economize water.

PROFESSOR DYCHE: I do not know that I caught the first of Mr. Brown's remarks, but these ponds are all connected one with the other by cement runways in which flash-boards and wire screens can be placed. The height of the water in any pond can be regulated by the height of the flash-boards. There is a system of pipes for water supply and drainage purposes, none of which are less than eight inches in diameter; these pipes will carry the water into the drainage of waste pipes and from pond to pond.

The drainage pipes take the water from the cement basins and from the deepest places between the ponds in the runways. One can see and know what is there before the water is started through the drain. The screens, when properly placed, will protect against the loss of any fish.

It is possible to know the condition of things all the time, since all these ponds are built independently of each other and can be so used as independent ponds; or they can be connected two or more together, if so desired.

EXPERIMENTS IN REARING BASS FROM NO. 1 TO NO. 2 FINGERLINGS

By Dwight Lydell

As the applications for bass in Michigan have been increasing at a remarkable rate during the last few years, it has become evident that something must or might be done to supply these applicants with fish. As no money was available for enlarging the plant and thereby increasing the output, and as nearly all applicants expect at least four or five cans, it occurred to me that if our bass of three-fourths to one inch in length, and put up at 500 to 1,000 to the can (according to the distance shipped), could be reared to about two inches in length and shipped at 250 or 500 per can, at least one-half more applicants could be supplied and they would be as well or better satisfied.

Anyone not familiar with the feeding of young bass of the length mentioned above has no idea what he is up against until he attempts to raise a few thousand. It is easy enough to teach the adult bass to take liver when cut up into strips to resemble a worm when sinking, but to prepare liver in this form for thousands of one-inch fish would be an endless task.

Unlike most other fishes, the desire of the bass, both large- and small-mouth, is for something moving, something alive. This makes it doubly hard for the fish culturist to find a prepared food or to prepare one that the bass will take in quantities large enough to make them grow rapidly. At the Mill Creek station in Michigan, where over one and one-half millions of bass in the various stages from advanced fry to no. 3 fingerlings are shipped each year, experiments in feeding the one-inch fish have been carried on during the past season with ground liver, beef, crayfish, clam meat and suckers.

Liver proved to be out of the question, as the bass would take only enough of it to keep them alive, and did not grow. Beef was a little better, but expensive. Suckers were tried with success, but as the source of supply was uncertain this food was discontinued. Crayfish the bass would take in almost unlimited quantities, and as we had an abundance of crayfish these were used almost wholly. Clam meat was tried with equal success and an abundance of this food was obtainable for the Mill Creek hatchery from the clam fishermen who supply the button factory with shells.

Our fish were kept in a small pond about twenty by forty feet, with natural sand sides and bottom. The crayfish after being run through a common meat grinder were fed to the fish every two hours for the first several days and they were given all they would eat at each feeding. After several days they were fed only four times a day or about every three hours. When fed in the above manner for four weeks they attained a length of two inches, when they were distributed. For lack of small ponds for rearing purposes only 2,000 fish were fed in this way.

BRIEF NOTES ON POND CULTURE AT SAN MARCOS, TEXAS

By John L. Leary

It has been observed at the San Marcos, Texas, station that during the past ten years the spawning season of the large-mouth black bass has without exception begun each season during the period of ten days from February 8 to 18. The average temperature during this month has ranged from 58° to 64° F. Crappie, bream, and rock bass begin spawning later, during the month of March when the temperature gets to be about 65°, though during the spawning period from the middle of March to the middle of May it may vary from 62° to 68°. It is when the temperature ranges from 65° to 68° that the fish spawn in largest numbers.

There appears to be quite an analogy as regards the season for spawning of fish and the blooming of plants and trees. However, this is no doubt due to the fact that atmospheric conditions suitable to development in the one case are equally applicable in the other. The cause and effect are common to both.

In the locality of the San Marcos station black bass are the first fish to spawn and the following trees and shrubs bloom about the same time: white elm (*Ulmus americana*), red bud (*Cercis occidentalis*), and the Mexican buckeye (*Ungnadia speciosa*). The elm is the earliest of the three, but all, however, bloom about the same time that the bass spawn, giving the idea that when these trees bloom the spawning season for bass has arrived, whereas, of course, it is the atmospheric condition that promotes both blooming and spawning. It is an accepted fact among the fishermen of North Carolina that the big runs of herring do not come into the sounds until the dogwood (*Cornus florida*) blooms, or about the middle of April; also that no sturgeon make their appearance until this tree blooms. Again atmospheric conditions play their part and produce the proper conditions for both the blooming of the tree and the spawning of fish. And as for the sturgeon, they follow the herring for the sake of their spawn, on which they feed, taking as they do their food by suction. The spawn of herring or any other fish makes an appetizing meal. These conditions, however, give rise to the idea that when the dogwood blooms there will be a run of herring and sturgeon. This nearly always proves to be true. The dogwood sign does for the fishermen, but they fail to realize that fish do not spawn until water temperatures become suitable, and that the spawning season varies with atmospheric conditions controlling to a great extent both water temperatures and the blooming of plants and trees.

Next I will give some brief observations as to the nesting of black bass. I am sure that the male does not in all cases build the nest; he is quite often helped by the female, for when the season and conditions of water come around they pair off like many birds and water-fowl and both assist in building the nest. But it might so happen, and often does actually occur in pond culture that in stocking the ponds the fish are not evenly paired—possibly more males than females—and the unpaired male has to work alone. After completing his nest he must look up a female, taking possibly some weaker brother's mate and thus causing the fights we so often witness without realizing the exact cause. The same may occur if females predominate. I further believe that when conditions of fish and water are right a male or female without a mate will nest and spawn, and that is why we so often see a nest with nothing on it, or a nest with the entire lot of eggs worthless. I firmly believe that nature asserts herself more strongly in the lower orders of life than in the higher types, and I feel sure that unless fish find the right location and suitable water conditions the results from spawning will be rendered abortive.

Now for some hints on pond building. I will say that if I were to lay out another pond-cultural station, I would not build a pond under one acre in size, and if water conditions justified I would make them much larger. The depth I would vary with climate, but always so that the ponds could be drained absolutely dry. In building banks I would make the long slope on the inner side. The ponds should be so located that an abundance of water can be supplied without the use of machinery or at least so that the ponds can be kept full by natural gravity flow, even if it is necessary to empty them by machinery, as pumping out once a year is much cheaper and much better than having to pump continuously to keep ponds to a standard of fullness. As to shape of ponds, just conform to the lay of the land; this will make them both more effective and picturesque. As to nursery ponds, if I intended to hold great numbers of fry to the fingerling size, I would build them several acres in extent and very shallow, say an average of about three feet with a slight increase of depth toward the draw-off. I still believe that it pays to stock all inland waters with fish from 1½ to 2 inches long.

SOME OBSERVATIONS ON THE CULTURE OF YELLOW PERCH IN PONDS

By W. B. Gorham

The following facts concerning pond culture of yellow perch (*Perca flavescens*) were noted while the writer was acting as fish culturist at the Erwin, Tenn., station. As many ponds unsuited for the propagation of the basses could be utilized for the culture of this other excellent fish, it seems possible that these facts may prove of interest to the members of this Society.

Upon my arrival at this station our brood stock of yellow perch consisted of one pair, about eight inches long, that had been saved from a consignment of bass brought by car from Meredosia, Ill. During my stay they received no particular attention, the other warm water fishes being given precedence in every way, yet from this little family about 2,000 fine healthy fish were distributed annually.

The pond in which they were reared was of the dumb-bell shape designed by the late William F. Page and of small surface area, being about one hundred and twenty feet long by thirty feet wide and contracted in the centre to a width of ten feet. The extreme depth at one end was twelve feet, shoaling to eighteen inches at the further end. The banks were for the most part rather steep, and were fringed with willows, the roots of which, with hair-like fibres, extended well out into the pond.

The fish spawned early in the spring at this station, the eggs being deposited in conglutinated masses on the willow roots, in water of an average depth of five feet through, the roots floating about eighteen inches from the surface. The eggs soon hatched, usually in ten to twelve days, the small fry hiding, and appearing later in schools as fingerlings, when they could sometimes be observed feeding along the shore line, if one used extreme care in approaching the pond. The adults were always left in the pond with their young, and from the number of young reared to fingerling size and shipped it would seem that they cannot be very cannibalistic. The adults were never fed, as far as I know, and as I have before stated were given little or no attention.

The ease with which yellow perch are reared, their good qualities as a food fish, and their ability to stand transportation, which they do better than any fish I have ever carried on messenger trips, all lead one to believe that their culture in ponds would be well worthy of undertaking.

A NEW AND ENLARGED FISH HATCHERY FOR THE STATE OF KANSAS*

By L. L. Dyche

I might say, gentlemen, by way of introduction, that I am from Kansas and that I have been connected with the Kansas State University in one capacity or another for a period of 34 years. At present I hold the chair of Systematic Zoology, and am curator of birds, mammals and fishes in that institution. Two years ago, the coming first day of December, I was loaned, so to speak, by the University to the Governor, Hon. W. R. Stubbs, and to the state in general, with the idea that the University should undertake to manage the fish and game business for the state. For about two years we have been undertaking to do that work. I still belong to the University and hold my position in that institution, and as a curator of mammals, birds and fishes still have charge of those collections, which are arranged in the first, second, and third stories of a museum building specially built and constructed for museum purposes.

The idea of having the fish and game department connected with the University originated with Gov. W. R. Stubbs. He talked practical, business, and scientific administration for everything connected with the state's business. We were urged by the Governor to undertake the work. We had some knowledge of fish and knew something about fish hatcheries, but had no practical knowledge of the management of such an institution. The fish and game protection business managed by a few hundred deputy wardens did not look good to us. It presaged trouble. However, parties interested, including the Governor and University Regents, urged us to undertake the work. We had serious apprehensions about getting mixed up in a business that had caused so much disturbance in various states, and did about

* Not a prepared paper, but taken by the stenographer from a talk where maps and blue prints were used for illustrations.

everything that one could do, without committing suicide, to keep out of it. However, we were forced into it and there was no apparent way of getting out, either by crawling, sliding, or by going up, down or sidewise. After we discovered that we were really hitched to it we began to think and look the matter over. After getting into communication with most of the good fish and game men of the country and possessing ourselves of the best reports and literature upon the subjects directly connected with the work, we began to plan for the future and have been planning and working from that day to this.

The state had a fish hatchery at Pratt, Kan., consisting of eleven ponds including four small cement retaining ponds. There were only seven ponds adapted to raising fish, and they averaged a little over an acre each in size. After looking this equipment over and studying its capacity and possibilities, we began to work on plans for a fish hatchery that would in a measure be more adequate for the possibilities of the fish interests of the state of Kansas.

We visited fish hatcheries and got into communication with fish men all over the country, and with various departments, particularly those at Washington, in regard to fish hatcheries and fish hatchery work. We then began our designs and plans, which we worked upon and changed until the plans you now see outlined on the blue prints and placed on the wall, for your inspection, were finally worked out.

When the Kansas Legislature went into session in January, 1910, it was necessary for us to go before that body and explain what was required for a good and practical fish hatchery for the state of Kansas, with its possibilities for raising good fish, especially food fish. We went before the Ways and Means Committee and presented an outline of the situation, and crude plans for a new and improved hatchery. The legislature, on recommendation of the Ways and Means Committee, finally appropriated for fish hatchery and other purposes about $80,000 and further appropriated all funds that could be collected for two years to come from hunting licenses, to be used by the Department of Fish and Game under the direction of the University Regents and the Governor. We re-wrote and assembled such laws as seemed good for the state, and had all the old laws repealed, some of which had been on the statute books so long that they were almost forgotten except when lawyers, especially county attorneys, would dig them up to beat or win cases that the game wardens were trying.

It is not easy to frame a law that will apply with equal justice to all parts of such a large and diversified area, but the legislature passed what we think is a good law for a state that has so many varied interests and with a territory 200 by 400 miles in extent.

We presented to the legislature, through its committees, drawings and plans for a hatchery something after the fashion and embracing some of the ideas outlined here in these blue prints. Of course, it was not complete and many changes and most of the details have been worked out since that time. We tried to explain to the legislature that it was necessary to have a new fish hatchery built upon new lines and in accordance with modern ideas; that we did not think it was economy on the part of the state to run a small, inefficient hatchery, or to keep a force of men and a good car to distribute a few fish. We further urged that to be an economic and profitable proposition a fish hatchery should be large and comprehensive enough to supply all the streams of the state with stock fish, and large enough also to supply the ponds that are now in existence and as many more as may be built for several years to come. We immediately got out a bulletin of 36 pages on the subject of ponds and how to build them on farms and ranches. Hundreds of ponds are now being built to raise fish and also to utilize the water for other purposes; one of the chief ideas is to have and raise fish for food.

We immediately got into a controversy with the sportsmen, who wanted nothing but black bass and true game fish, and the farmers, who wanted fish in some quantity.

A careful study of the situation required another bulletin on fish, explaining our plans and ideas to both sportsmen and farmers of the state. In this bulletin we gave some advice as to what particular varieties of fish should be placed in ponds and in streams. The treatment of the subject made it necessary to take into consideration all the streams and ponds in the state of Kansas, the kind of water, etc., because conditions and the supply of fish vary in different parts of the state. The fish living in the Kansas River between the Missouri River and Manhattan are, in the main, different from the fish that live in smaller streams in different parts of the state. We have such fish as buffalo, redhorse, catfish, carp and drumfish in the larger and muddy streams, but no bass, crappie or sunfish.

With plans and ideas of a new hatchery advertised people generally became interested and have asked for so much information that it has made a demand for a bulletin on fish culture adapted to the conditions of Kansas streams and ponds. Bulletin No. 3, on "Pond Fish Culture," will be the next one issued. These bulletins might be called "farmers' bulletins," as they are primarily intended for the people of Kansas and are especially adapted to cover the conditions found in our own state.

This is not a hatchery intended for raising trout. Kansas has no streams that are adapted for trout culture. The hatching and the raising of black bass is a very different proposition. Most persons who have streams or fish ponds clamor for black bass. Both black bass and channel catfish are asked for by nearly every person with a quarter or half-acre pond. The channel catfish will not breed in ponds and the black bass is not adapted to small ponds.

Now, I want to show you a map of the state of Kansas, which state is 400 miles from east to west, and 200 miles from north to south. The fish hatchery is located just west of the center and in the southern part of the state; it is in Pratt County, and two miles east of the town of Pratt, which is on the Santa Fé and Rock Island railroads.

It was necessary to get a law passed by the legislature to protect fish in public streams, and especially young fish. If the small and young fish are not protected there will not be any old and large fish. If we do not take care of young chickens and pigs we will never have any grown chickens or hogs.

Another snag we struck was the market fishermen. We called them together in different places and at different times and talked to and tried to reason with them. I could talk to them but there was no reason on their part. They wanted a law to suit themselves, otherwise no law at all. In fact, they wanted no law at all. They all fought my proposition for fish protection and regulation, so that it was necessary for me to go to the legislature and present the matter to the House of Representatives and to the Senate at frequent intervals covering a period of over two months; so that when the bill finally came up every man in the legislature knew more or less about fish, and there were twenty men who had become so interested that they wanted to speak all at once. The fish and game warden was allowed to speak several times on the bill in the Senate and also in the House of Representatives, in order to explain further the nature of the law and its especial advantages for both fish and people. A law was finally passed which we think is good for both game and fish in Kansas, and we are undertaking to enforce that law, and I am having a lot of fun, not to mention other things.

To begin with, the fish law provides that a man can fish with a hook and line any time of the year and take any and everything that he catches, provided he uses but one hook on a line. Three or more hooks make what can be used as a grab hook, the use of which was formerly permitted, and men have caught great quantities of fish by that means, especially in winter time, fishing through the ice in places where fish were bunched up in schools and bedded. By this method many fish were not only taken, but many were snagged and crippled that were not caught.

In the southern part of the state tons of fish were reported to have been taken in one locality by spears and grab hooks, by fishing through the ice; so a law was framed to cut out the grab hook. One hook is enough for sportsmen. The fishermen can use 25 hooks on a trot line. We try to avoid snag hooks and drag hooks, and all kinds of unsportsmanlike schemes to catch fish by unfair means, especially in the winter time.

Another provision is this: One man may fish with but one trot line and may not hang more than 25 hooks on it.

Then the question of nets and traps arose, and that provoked considerable discussion. We recommended that all kinds of traps and nets be made unlawful, except a seine with meshes three inches square. Then the farmers appeared, saying that they had no time to fish with hook and line, and if they did they could not catch anything. They said that they wanted a law that would allow them to catch a mess of fish once in a while. We explained that we would have a law that would allow them to use a seine just as long and just as wide as they wanted it to be, but the meshes must be three inches square. The idea is that you must not catch with a seine a fish that weighs less than three pounds. If a fish weighing less than three pounds is caught it must be put back into the river.

The law requires that a $50 bond with two sureties be put up by the person who desires to own and use a three-inch mesh seine. We have received several letters from farmers indicating that they had made successful catches of fish. One party of farmers caught about 300 pounds of fish weighing from 3 to 16 pounds each; one member was appointed to write the Department of Fish and Game that they thought the law was a good one, and that they were well pleased with it. The farmers are satisfied, the sportsmen ought to be and the market fishermen have to be, so that we have the fishing business fairly well regulated by law. However, it is no easy matter to enforce the law against the market fishermen and some others who do not want any kind of a fish law.

On the Kansas River, two years ago, we found in the possession of one fisherman 1,200 small channel catfish. It took seven of those small fish to weigh a pound, and we were informed by one man that he had taken 30,000 channel catfish of that size from the river. There is no use trying to raise fish under such conditions. If fish of the larger varieties are allowed to stay in the streams until they weigh three pounds, the chances are they will spawn once before they are caught. By protecting the young fish we expect to increase the supply of fish considerably in our state in a very few years. With this explanation and understanding the law for the protection and care of fish was passed. With over 300 game wardens who are trying to enforce the laws and who are looking out for the interests of the people, the game and fish business in Kansas is in very good shape at the present time. These wardens serve without pay, except that they get $10 which is assessed as a part of the costs against each person who is arrested and convicted for violating the law.

At Lawrence, Kan., my home town, it was necessary for us to arrest a dozen men in one day. These men were old friends of mine, who had caught fish for years for me for laboratory use; but they simply would not quit using unlawful nets until they were arrested and made to do it. We arrested the whole bunch, took a wagonload of nets and hauled them through the city to the court house. After a few lessons of this kind even our fishermen friends had a very great deal of respect for the fish laws.

Since the new fish and game laws were passed we have given most of our time to working and studying over plans for a new fish hatchery. We got $80,000 from the legislature, as much of it to be used in building a fish hatchery as we thought advisable, and in addition, all the money we could collect in the next two years from the sale of hunters' licenses. A law has been passed requiring licenses to hunt rabbits, and we will receive the money collected for licenses for two years to come, in addition to the appropriation we already have.

These laws do not apply, of course, to private ponds, but only to public waters. A man who builds a pond on his own land holds it as his own private property and can do what he pleases with it; but all the streams, lakes and bits of water fed by streams come under the provisions of the law. Naturally, moreover, men who build ponds usually take the best possible care of their fish and are anxious to learn about fish culture.

These 22 blue prints that you see on the wall will give you some idea of the plans and make-up of the new hatchery that Kansas proposes to build. These eleven ponds [indicating on blue print] four of which are small cement retaining or storage ponds, make up the old hatchery. By condemning and purchasing about 100 acres to the west of the old hatchery, the state now owns over 160 acres of land which stretches along the south side of the river [indicating] for a mile. This ground is just the right elevation for ponds that can be filled from the proposed water supply and yet be drained, dry if need be, into the Ninnescah River, which flows from west to east along the north side of the proposed hatchery. This river flows through a low bottom or valley about a quarter of a mile wide, sufficient to carry all storm and flood waters without overflowing or interfering with the hatchery ponds. The hatchery grounds have a slope from west to east of about 16 feet per mile, sufficient for a good gravity run for the water through the pond system.

The pipe line will bring the water from a distance of one and one-half miles west of the hatchery grounds. The water will be carried through a 21-inch pipe. It will be fed from a 5 or 6 acre lake made by constructing a cement dam 500 feet long across the Ninnescah. In laying this pipe line no cut will have to be made deeper than one and one-half feet. The Ninnescah River (more properly speaking a creek), which will supply this pipe and the hatchery with water, has its origin in springs about 8 miles west of the hatchery—no large spring, but a great many small ones. Dry weather does not seem to affect this stream. It runs water enough to supply three or four pipe lines such as the one that will feed the hatchery ponds.

The 21-inch pipe carries the water into a receiving pond from which five distinct streams of water will flow by a gravity run through the 100 or more ponds of the hatchery.

In selecting a site for a hatchery to raise bass, crappie, sunfish, and catfish we gave our especial attention to the possibilities of a food supply for both old and young fish. Water that runs 12 to 15 miles (measured as the river runs) through patches of plants, little pools, swampy places, and is finally collected in a seven acre shallow lake, from which it is delivered to the hatchery ponds, must of necessity be pretty well supplied with food material for fish, both young and old.

The Ninnescah River for five miles above the hatchery grounds is well supplied with vegetation, including water-cress and various kinds of water plants that grow in good, clear water. This river is also well stocked with small fish, particularly minnows, of which there are great schools. Insect, crustacean and small plant life is also abundant.

We have made something of a study of the food habits of the bass. One thing is sure, they must have a good and plentiful supply of food. One hundred spawning bass in a two-acre pond will devour somewhere (according to experiments) from three to five times their own weight in food each year, and this food is taken alive. It is hard to keep and breed any kind of small fish, such as minnows and cray-fish, in ponds stocked with bass. The bass soon eat up the stock supply. About fourteen bushels (measured in water) of tadpoles (of the large green bull frog variety) were placed in one pond. They did good service. The bass would not eat the tadpoles, but took them as fast as they developed into frogs. About 5,000 yearling goldfish and 50 pairs of large spawners were placed in the same pond. The yearlings were all taken, but most of the old goldfish (weighing from one to two pounds each) escaped. However, all the young goldfish were taken by the young bass of the season. This same pond was supplied with hickory shad, old and young, and river minnows. About 50 pairs of crappie spawners were in the same pond. When drained in the fall there were about 35,000 young bass and crappie. The young bass were feeding upon the young crappie and upon each other, and the old bass were feeding upon both young bass and young crappie, and almost any live thing they could find. The goldfish were all gone except about half of the old spawners. There were a few tadpoles left that had not changed into frogs and a few small minnows, but none of the 500 goldfish that had been thrown in the pond about two weeks before. These bass had learned to come to certain places to be fed and would take goldfish as fast as they were thrown in.

One fish, taken from this pond with a hook baited with a goldfish, had five goldfish in its stomach. This fish weighed about two pounds and the total length of the five goldfish found in its stomach was greater than the length of the bass itself; yet it bit at the sixth goldfish. There were 100 bass in that two-acre pond and if each one took five goldfish for a meal the supply of 500 would be devoured at one meal. Last fall, while moving bass from one pond to another, we found that a bass weighing 2¾ pounds had caught a bass weighing 2 pounds and was trying to swallow it, the smaller fish being head and shoulders in the mouth and throat of the larger. It took some work to separate them, then both swam away. It is not an uncommon thing to find fingerlings and yearlings that have choked to death trying to swallow their brethren.

The number of bass that can be raised in a body of water depends largely upon the amount of food it is possible to furnish them. If food is not plentiful the little fellows only an inch and a half or two inches long become cannibals at once. It is not an unusual thing to find a young bass swimming about with the tail of another young bass sticking out of its mouth.

We have received many letters from people who want to know how to keep the moss out of their ponds. We consider a good growth of moss of great advantage to fish ponds. It furnishes an abundance of food either directly or indirectly for most varieties of fish, and is especially valuable for the protection of young fish.

We will not have time, and the expense would be too great, to seine and sort fish in a hundred ponds. We propose to leave the fish, old and young, in the ponds until they are drained, which for the most part will be done during the fall months. The ponds in this new hatchery can be connected one with another by water supply pipes and by open cement ways 29 inches wide. Food fish for both large and small bass can be raised in adjoining ponds. The ponds can be separated by flash-board and wire screen gates. This arrangement will permit of many things; for instance, the young bass can pass through wire screen gates into ponds stocked with minnows and goldfish and this will give the young bass a chance to feed on the young of other fish. This food pond will be in readiness for the young bass as soon as they are able to make their way into it. This is one of the methods that we propose to use in the feeding of young bass. Ponds with yearling goldfish and other fish will be in readiness to supply the spawning bass with food.

The black bass seems to do well in many Kansas streams. They have been there since the earliest settlers made homes in the state, over 50 years ago. We hope to keep the streams stocked with these fish. In Kansas every sportsman wants to fish for black bass. My favorite scale fish for ponds, however, is the giant crappie. These fish do well in ponds and are very prolific. In planning the hatchery we looked to an arrangement that would not only produce bass, but giant crappie.

Another fish for which there is a considerable demand is common bullhead catfish; we will raise them. We have been experimenting with them and find that they can be fed on corn, wheat, meat, potatoes, bread and such material. They grow in three or four years to over two pounds in weight. We exhibited a bunch of them at the state fair at Topeka, and most of the farmers who saw them said that those were the fish they wanted. We will supply them with the best species of catfish. They are especially desirable because of the great variety of food they consume and also on account of their hardiness and their ability to live in a small amount of water during dry spells. We have fed them on corn bread, graham bread, potatoes, bran, cornmeal cakes; in fact, they will eat almost anything. A thousand of them will come up at the same time near the surface of a pond to feed in a place where they have been accustomed to be fed. It is a good idea to give them some meat and liver; but the main part of the food that we gave them was vegetable matter, because ordinarily it is cheaper and easier to handle than animal food.

Considering all the things that we hope to accomplish, and considering the fact that Kansas has 80,000 square miles of territory, and taking into account the number of fish that one acre will produce, our hatchery of 100 acres of pond water will not be a large hatchery for a state like Kansas.

Here [indicating on map] you have a bird's-eye view of the number and the arrangement of the ponds of the hatchery. There are 83 ponds in this section in the proposed new hatchery, and from 12 to 20 more to be built later on. There are 11 ponds in the old hatchery, but four of these are small cement ponds used for handling fish. The contract will be let in a few days for the building of these 83 ponds.* The

* This contract was let to James A. Green & Co., Inc., of Chicago, November 21, 1911, the work to be completed by August 1, 1912.

ponds and water system of the old hatchery will be rebuilt separate from the contract for the new hatchery.

We will leave the old hatchery as it is for the present, in order to hold over fish for the proper stocking of the new ponds. The old part will not be rebuilt until the new part is finished and stocked. The ponds in the new hatchery will vary in size and shape, but will average about one acre each. When normally full no pond will have less than six feet of water in the deepest part. The water will grow shallower toward the perimeter. This arrangement will furnish good feeding grounds for the young fish in the grass, weeds and moss growing near the shore line. The embankments will be made of earth. We have had no success raising fish in a pond with cement walls instead of earth embankments. There is not sufficient shallow water near the shore line for the young fish to feed in; and not a sufficient growth of vegetation to furnish and support fish food in such a pond. The cement pond seems to be a failure so far as raising fish is concerned.

Other ponds with steep banks and deep water near the banks have not proved satisfactory, yielding but few young fish. The ponds of about an acre in size with a considerable amount of perimeter and shallow water with vegetation growing in them have proved most satisfactory as fish producers. To illustrate: Take this pond [indicating on the map] in the old hatchery. We have a pond here of a little less than an acre, with shore line and vegetation as previously described. A year ago last spring we stocked it with about 88 giant crappie or strawberry bass. We left them in the pond the entire year. They did not cost anything, so far as any special labor or care was concerned, as they were not fed, except that the pond was stocked with goldfish. We paid little or no attention to them except to keep the turtles out. They required only seining and sorting. We drained the pond last spring and counted the fish, as it was an experiment. We took out 14,600 crappie nearly a year old, and found the old fish in good condition. The pond was a solid mass of vegetation in the fall, which somewhat disappeared during the winter. When we drained the pond in the spring it was necessary to pile up the moss and water plants in places with forks; this was done when the water was low enough to wade in with rubber hip boots. The water was about two feet in depth when we seined out the large fish. We then let the water run out slowly and picked out the little fish with minnow seines and hand nets.

This one pond containing two acres of water shown on the blue print was overstocked. We had 200 bass in that pond and about 100 crappie, and an undetermined number of sunfish. We did not have the success with it that we hoped for. When we drained the pond, we got, if I remember correctly, about 12,000 bass and about 8,000 crappie, about 20,000 fish. However, unknown to me, there were about 400 yearling bass in that pond that had not been taken out the year before. Now, if there is anything that is destructive in a breeding pond it is yearling bass. There were, also unknown to me, about 600 yearling crappie in the same pond; so we had 400 yearling bass, and about 600 yearling crappie to contend with; and that would evidently reduce the number of young fish.

Yet I would rather take the number of young fish that we secured at almost no cost of raising than a larger number that could be raised at the expense of keeping the pond clean and the added expense of caring for them all summer, seining them and sorting them. We do not intend to seine or sort fish if we can get along without it. We want to produce the proper conditions for the breeding and spawning of each kind of fish that we raise, but we do not expect to handle them until fall or spring, when we drain the ponds.

We prefer to drain bass ponds in the fall and crappie ponds in the spring. We think it is a great advantage to put crappie in with the bass and breed them together in every pond. This year we had crappie in with the bass; the bass ate a considerable number of crappie, but that made no difference as we had to feed the bass on something. When we drain the ponds we find about as many young crappie as young bass, notwithstanding the fact that both young and old bass feed on the young crappie. We have never had enough goldfish, although we raised 100,000 this year, to supply the bass ponds. We have never been able to catch minnows enough in our part of the country to amount to much as bass food. Three or four men working all day would, as a rule, only get a few thousand; and again minnows are hard to handle and keep alive when they have to be transported any distance.

Not being able to catch minnows in any quantity, we expect to try to raise them in ponds for fish food; we also expect to run them into the hatchery from the river through the conduit pipe. By the use of wire screens we expect to pass the minnows into certain breeding ponds and allow the young fish to pass into certain minnow ponds. We expect to raise goldfish in great numbers for fish food, and will also raise carp for the same purpose. Gizzard shad also have done well as a food for other fish. The shad have apparently done us good service when bred in the same ponds with the bass. At least, when we drained the pond we found nothing but old shad in with the bass, although in the summer season we noticed thousands of young shad swimming in schools; they had all apparently been devoured before we drained the ponds.

Thus we have been experimenting with a few ponds with more or less success. However, the successes and failures we have had have given us ideas for the founding and the building of the new and improved hatchery. We have not been guided alone by our own experience, but have tried to profit by that of every other fish culturist in the country.

The Kansas State Fish Hatchery, as planned, will be a quarter of a mile wide and a mile long. The water from the supply lake, one and one-half miles west, will be brought through a 21-inch pipe and delivered into Pond No. 1 [indicating on map], which will act as a receiving pond, and from this pond five streams of water will start and connect with and flow through all the other ponds. The ponds are all connected, as stated before, by cement runways 29 inches wide and with supply and drain pipes. The walls of the cement structures conform to the contour of the embankments, but are about a foot higher on the sides of the earth embankments than the banks themselves. There are grooves in the walls of these cement structures for receiving the stop-boards and the wire screens.

There will be about a dozen small houses located at different places on the grounds, for storing tools, material and the wire screens not in use. There will be three or four houses for superintendents and regular employees. We also intend to install a telephone system so that the main office can communicate with a dozen or more stations on different parts of the grounds. There will be about four miles of roadways, wide enough for automobiles, and several miles of roadway embankments not so wide, but wide enough for smaller vehicles and for "foot passengers." All the roadways are over the embankments and run for the most part the long way of the hatchery grounds, east and west, but the connecting roads run north and south. The cement waterways connecting the ponds will be covered with cement slabs, strong enough to support the vehicles that pass over them.

The ground that is to be converted into ponds is very irregular, full of ups and downs. This is very fortunate for pond construction, as nearly every pond in the system has its centre near a low place. This accounts for the irregular shape of the ponds. The amount of earth to be removed in forming the pond basin is in most cases just what is needed for the embankments for that particular pond. There will be very few long hauls. This will make very economical construction compared with work on a level piece of ground where the ponds would have to be excavated or dirt hauled a longer distance to build the embankments.

Many of these blue prints are full of details, intended especially for the engineers and contractors. I do not care to bother you with the details of construction. I am trying to give you only a general idea of what the proposed hatchery will be.

Take Pond 52, for instance. The water can be cut off from it without interfering with any other pond. This Pond 52 can also be drained without interfering with the water supply or drainage of any other pond. This is the system arranged for all the ponds.

Each pond in the system can be either filled or drained in from 24 to 36 hours. We find it to be of great advantage to be able to fill or drain a pond in a comparatively short period of time; however, the ponds may be filled and drained slowly, by turning the water on or off, as the occasion may demand. The smallest drain pipe used is eight inches in diameter. The river into which the water is drained is a few feet below the level of the bottom of the ponds, which fact makes a good drainage system possible.

These blue prints showing so much detail of inlets, outlets and valves, I will not undertake to explain unless you want especially to know about them. It would be rather out of place at this time in this rambling account of the proposed new hatchery.

We have been connected with this hatchery work for about two years. We have always felt that Governor Stubbs and others concerned pushed or forced us into it. We were pretty well satisfied with our University work before we undertook this job. However, after we discovered that we were in the business we tried to "get busy," and have done the best we could. We began at once to study the hatchery business and began to plan for a hatchery adapted to the conditions of our own state. We talked fish hatchery to everyone and talked it all the time. When the time came we presented the matter to the legislature and tried to explain what we thought Kansas ought to have. We stood for a good hatchery, one that we thought would be a benefit to all the people of Kansas. We tried to explain that after such a hatchery had once been built and equipped it would not cost much more to operate and maintain it than it would to run a much inferior one. We tried to stand for the right kind of economy, the kind that would bring practical results. We took the ground that the streams of Kansas could be stocked from the hatchery and made valuable as fish producers, that pond fish culture could be made valuable for the farmers, that farmers should be encouraged to build ponds, that each farmer who was enterprising enough to build a pond should receive fish in the shortest possible time from the state fish hatchery, and that we proposed to take them to him free of cost. We expect to deliver them from the state fish car when possible, otherwise send them by express in ten-gallon milk cans, with an attendant, to the farmers' nearest station.

Another point that we tried to explain was that instead of taking the farmer little fish, fry, fingerlings, etc., we would take him fish two years old, fish old and large enough to spawn. We expect to keep the fish in the hatchery until they are large enough to spawn. If we do not have ponds and water enough to do this we will get more land and build more ponds. When a farmer completes a pond and wants fish, he wants them right away. We want to be ready to supply him with from ten to fifty pairs of spawners, in proportion to the size of his pond. Such a delivery of good, large, plump fish will please the farmer. He is excited about the fish business and has been ever since he began to build his pond, and wants to get to work right away. We want to help him just at the right time and in the right way.

We have tried delivering little fish and big fish to farmers with ponds. Little fish make them look serious and ask a lot of questions. Big fish make them smile and look happy. The delivery of fish two or three years old puts them in the fish business immediately, and they are quick to see that it will be only a short time until they can expect to eat fried fish from their own ponds, and plenty of them, which makes them feel good.

DISCUSSION

MR. D. B. FEARING, Newport, R. I.: You will be Governor of the state of Kansas in two years. (Applause.)

PROFESSOR DYCHE: Thank you. I will now be pleased to have you feel very free to offer any and all kinds of criticism relative to the ideas presented and plans that I have been showing you. I have been seeking help from every direction and am still seeking more help. We want to build a good fish hatchery for Kansas, and I want to make it up to date, if possible, being guided and directed by the ideas of men who have been working and thinking along these lines.

MR. MEEHAN: I want to ask what you fed the crappie?

PROFESSOR DYCHE: Nothing at all; but we try to provide conditions that will furnish natural food supplies not only for crappie but for other fish. We are not going to feed fish—that is slow business, it seems to me, for most of the kind of fish that we are going to raise. We have fed corn, wheat and bread successfully to catfish and carp. Last year we fed a lot of carp, channel catfish and bullheads during the fall, winter and early spring, and brought them out in fine shape on corn chop and bread. During the present summer we have fed a few thousand catfish (bullheads and channel cats), together with goldfish and bluegills, all in the same stock ponds. Some chopped meat and liver was added to the bill of fare. These fish learned to eat almost anything in the way of meats, vegetables and grains. They seemed especially fond of table scraps. The fish described are in stock ponds and are being held to stock the new ponds when finished and in condition for fish.

MR. L. A. GESERICH, St. Louis, Mo.: How are those lakes constructed so far as the control of the water is concerned—how do you drain them—by valves?

PROFESSOR DYCHE: By valves.

MR. GESERICH: Each one is connected with a valve?

PROFESSOR DYCHE: Yes.

MR. GESERICH: You can drain them all if you want to?

PROFESSOR DYCHE: Drain them all or drain one independent of any of the others.

MR. S. G. WORTH, Mammoth Spring, Ark.: What style of pipe is used in the drainage?

PROFESSOR DYCHE: We will use about 26,000 feet of vitrified clay pipe; the sizes will range from 8 to 21 inches; the joints will be sealed with Portland cement under the direction of a resident engineer.

MR. WORTH: The reason I asked that question is that it has become a conviction in the Bureau of Fisheries, I believe, among the superintendents, that terra cotta pipe is a very bad thing.

Professor Dyche: We expect to use vitrified clay pipe and cement the joints, using methods that have proved satisfactory in other parts of our state in connection with water-works and sewer systems.

Mr. Worth: I hesitatingly make any suggestions to the gentleman because after many years' experience in this class of work I must say that I am highly delighted with what I have heard, for it seems to me most practical, but I just wanted to call attention to that one thing of terra cotta joints made with cement mortar.

Professor Dyche: The system that we will use has been operated successfully in several parts of our state.

Mr. Worth: I would like to make my point clear. If there is a leak in the underground system of drainage beneath the bottoms of the ponds the crayfish will work through the opening up into the pond bottom and make an underground leak in the pond.

Professor Dyche: I do not see where any crayfish could get in between the pipes. They could not do much in an eight-inch pipe if they went in with the water except to get out again. Crayfish could not interfere with the flow of the water in our smallest pipes, which are eight inches in diameter. The system is the same as the water and sewer systems of the state. Prof. W. C. Hoad, engineer at the University, who looks after the sewer and water systems of the state, told me when I brought up the subject of crayfish that there would not be a joint in the entire system of piping that would admit of a crayfish entering. He said that the joints would be absolutely proof against such marauders.

Mr. Worth: If the joints are good it will be all right.

Professor Dyche: The engineer is to see every particle of this work done. Every earth embankment is to be built in a certain way; they are to be kept level and be built in even layers; the engineer will be on the ground to see that every inch of work is properly done. The specifications call for a great number of specially constructed and detailed things. The engineer will see that the plans and specifications are followed in construction. This engineer, Professor Hoad, is one of the most competent and experienced men in the country and has charge of all the sewer and water systems of the state of Kansas. He has had his men working for about six months preparing these drawings for me. We always got together on any part of the work and studied it until we thought we knew what we wanted. We availed ourselves of all information we could command before we acted. After we decided upon any plan or system or way, Professor Hoad and his assistants worked it out with great care from an engineer's point of view.

Mr. Geserich: How many ponds have you?

Professor Dyche: There are 83 in the new hatchery, 11 in the old, and about 15 to be built after the new hatchery is finished.

Mr. Geserich: Where do they drain?

Professor Dyche: Into the Ninnescah River, which flows parallel with and just north of the hatchery grounds; there are several places where the drainage pipes empty into the river.

MR. GESERICH: Suppose you wanted to drain Pond No. 32 for example?

PROFESSOR DYCHE: Pond No. 32 is on the south side of the hatchery and one of the farthest from the river. It will be drained through the pipe that has been laid under its north bank. The water will enter the drain pipe at the northeast corner. This same drain pipe you see [indicating on map] leads almost straight north to the river. Ponds Nos. 31, 30, 41, 39, 40 and 42 you will notice discharge their water into this same drain pipe; there are several drain pipes leading to the river, making a number of almost separate systems.

MR. GESERICH: In other words, you have runways for each and every pond?

PROFESSOR DYCHE: Yes. I have another blue print; one that shows every drain pipe and runway. There are usually 8, 10 or 12 ponds hitched to any one system or runway; but these eight-inch pipes lead to and connect with larger pipes that carry the water to the river.

DR. TARLETON H. BEAN, Albany, N. Y.: What provision do you make against the crayfish working in those embankments?

PROFESSOR DYCHE: There is no provision for that. Crayfish have never bothered our banks. A bushel or more of crayfish was once dumped into one of the bass ponds and they soon disappeared. When we drain the ponds we do not find any of them.

DR. BEAN: But how are you going to prevent crayfish from boring through the embankment from the outside?

PROFESSOR DYCHE: In one sense of the word there is no outside to the embankments surrounding such a system of ponds. We have one embankment running right up against the river in the old hatchery and we have never been troubled with crayfish boring in it. I do not know of a single case. This river is well stocked with channel catfish and black bass. These fish may keep the crayfish cleaned up; however, crayfish have at times in the past been purposely placed in the river.

DR. BEAN: Then there are no crayfish left. One of our problems is to prevent them from making trouble. Have you much frost there?

PROFESSOR DYCHE: Very little. The vitrified clay pipes will be placed from three to five feet underground.

MR. W. T. THOMPSON, Fairport, Iowa: If anyone were to ask me for a definition of the word enthusiast, I would simply point him to Professor Dyche and say: "There is your enthusiast personified." I do not believe Professor Dyche's applications will be limited to the state of Kansas if he furnishes the farmers fish weighing three pounds. I remember hearing of one member of this commonwealth (Missouri) sending in an application to the government for catfish. He was notified the fish would arrive by car at a certain time. He went to the car, the captain passed him out several cans of fish, he took off one of the covers, looked inside and saw that the fish were only about three or four inches long. Turning his nose up in disgust he said as he walked away: "Oh, hell, I thought you were going to give me some big enough to eat."

Mr. George H. Graham, Springfield, Mass.: I cannot help having a kindly feeling toward Professor Dyche. I believe he is on the right track, and if every commissioner in the United States were on the same track that he is, we would have something done. He is trying to popularize the work, and he is going at it in the right way.

In the first place he has gone to the legislature with a concrete proposition; he has told them what he wants to do, and is putting it up to them as a business proposition. It is not any fad, such as we have in a good many states. It is a business proposition; he got all the money he wanted. I believe that any commissioner can go to the legislature, and if he can convince the legislature that he is going to do something for the benefit of all the people, he can get what he wants. We in the eastern or the central part of the country would not take up the kinds of fish that he is handling; but he has taken up the fish that they can raise in Kansas, and he is getting the people interested.

In the eastern part of the country I believe we can get a great many farmers who have small streams interested in raising brook trout. I had an article printed in a newspaper to that effect and immediately six people came to me and asked if I could give them any literature to aid in constructing ponds in which to raise brook trout. They had plenty of good water, but did not know how to use it. Well, I wrote around to some of the different commissions and to the Bureau of Fisheries, and to Mr. Townsend in New York, and tried to get some information. All I got did not amount to very much. There does not seem to be anything printed that is very good to send to a farmer who is green at the business, which will show him how to go to work to raise these fish. My idea is that we should endeavor to make the work more popular. You get a hundred farmers in a county interested in raising fish, having trout ponds, etc., and they will help you in the legislature, and in many ways in the work, and that is just what Professor Dyche is doing out in Kansas. I believe the more people we can get interested in fish culture and the propagation of fish and game at the same time, the more popular will become the work of the fish and game commission, and when you can make the work very popular, you will get all the financial support from the state and national government that you want. Professor Dyche is on the right track, and I believe we have all learned a good deal today from what he has had to say.

Mr. Meehan: I think we can agree there, for in Pennsylvania, when it was announced that we would raise catfish and other commercial fishes they increased our appropriation from $35,000 to $205,000.

Mr. Fearing: As a fish commissioner of Rhode Island I want to thank Professor Dyche from the bottom of my heart. He does not know what it is to go before a legislature that thinks there is "a nigger in the woodpile" all the time. Mr. Graham stated that any legislature would do anything if it was put before them as a business proposition.

We have tried very hard to convince our legislature that lobster culture is a business proposition, but we cannot make them do anything and we get mighty discouraged sometimes. But what Professor Dyche has done puts new life into us; and if we all looked at things the way he does, perhaps we would all do better work.

Mr. Graham: I think the legislature of Kansas has absolute confidence in the state commission.

Mr. Fearing: Our commission is curious, in that it is working for the love of the cause and without pay.

Dr. S. P. Bartlett, Quincy, Ill.: Professor Dyche has overcome difficulties that seem insurmountable. I have been before the legislature 35 years endeavoring to accomplish similar objects, and fully comprehend the difficulty of the work.

I cannot say anything about the workings of those ponds, but the idea is mainly the rescue of the fish. I like his plans for the distribution of the different varieties, but I could not be loyal to the interests I have represented if I did not object to his cutting out carp.

Professor Dyche: I am a great friend of the carp. I will talk carp to you for an hour if you wish.

Mr. Meehan: That subject is tabooed.

Mr. W. O. Buck, Neosho, Mo.: I wish Professor Dyche would explain some details, especially in regard to the openings. The problem of controlling the outlet of the ponds is a difficult one for me, and I imagine it is the same at most stations. I wish Professor Dyche would explain what arrangements he has for getting absolute control of the fish.

Professor Dyche: You mean for getting water from the pond to the river?

Mr. Buck: No, holding the water, preventing leaks and holding it at just the height you wish. How about leaks?

Professor Dyche: Our engineer, Prof. W. C. Hoad, of the Kansas University, will use practically the same system of cement runways, pipes and valves that he has installed in other places in the state in connection with water works and sewer systems. Between any two ponds he constructs a cement runway, 29 inches wide, built up on both sides; and this cement structure runs down into the water on both sides and the wall on the sides of the embankment is one foot higher than the earth embankment. The flash-boards are put in so as to regulate the height of the water in the pond. Wire screens of different sized mesh will be used to regulate the fish. The stop-boards fit so well that there is practically no leak. In a gravity run such as we have there is no great pressure anywhere and consequently no leaks except where poor workmanship or some accident might cause it.

Mr. Buck: The flash-boards are set horizontally, running in slots in the concrete, are they?

Professor Dyche: Yes. The engineer has such flash- or stop-boards in good working order in other localities. I might say that the engineer, Professor Hoad, and myself visited Mr. Buck at Neosho, Mo., and examined the government hatchery that he is directing.

Mr. Worth: I will venture the assertion that Professor Dyche has the largest and most comprehensive pond system in the United States and perhaps in the world. I certainly admire it.

Professor Dyche: There is one part of the station planned as you see on this map (indicating) that will not be finished at present. It will be built after the present station is completed. I refer to the remodeling of certain ponds and the adding of a dozen or twenty more which have already been planned. We will build 83 new ponds now and after that there will be enough more to build to make 107 ponds which will cover about the same number of acres of water.

Mr. G. W. N. Brown, Homer, Minn.: Don't you think it better and more economical to make your ponds more regular in shape, so that the drain pipe lines will be straighter?

Professor Dyche: That is a good question. This ground is very peculiar. There are bumps and hollows, ups and downs; and the ponds really located themselves in natural depressions; it will only be necessary to remove enough dirt to give the pond basin proper shape and to make the embankments. Therefore they are by nature irregular in shape and size, but this is immaterial for fish-cultural purposes. It will make construction economical, because we take advantage of the natural contour of the ground.

Mr. Brown: The topography of the ground shapes the ponds?

Professor Dyche: Yes.

Mr. Buck: You have to dig under each of your embankments to make your outlet pipes?

Professor Dyche: The pipes will be laid before the embankments are built and will be under the dikes. The work will be done in such a way under the direction of the resident engineer that one part will not interfere with another, but the pipe lines will go in first and the earth will be filled in over them.

Mr. Buck: If there should be occasion to repair them you would have to dig pretty deep, would you not?

Professor Dyche: Yes, but the pipes will be directly under the embankments, so that they can be easily reached; we expect to put in a system that will not need to be dug up, except perhaps in rare instances.

Mr. Buck: After you get your embankments built they will be some ten feet under ground, will they not?

Professor Dyche: That is true; but the pipes will be accessible if it is ever necessary to dig any of them up.

Mr. Thompson: Professor Dyche has told us of a number of pamphlets he has written which have been issued by the state. I suggest that he write just one more, on the subject of: "How I Did It." I think it would be a good lesson to all the members, and more especially the state commissions, to learn how he manages to have the state of Kansas build one large hatchery instead of half a dozen little one-horse affairs, scattering their money all over, entailing considerable unnecessary expense in construction besides an enormous annual outlay for propagation and repairs at all these different points, instead of centralizing it, as they have done, at one point. I think this is one of the most sensible things the Kansas Legislature has done, outside perhaps of providing for Professor Dyche as Fish Commissioner.

In many of the smaller states of the East, not referring, however, to the baby state—Rhode Island—so ably represented here, but in New Hampshire, for instance, they had about seven hatcheries at one time. Their appropriation was small and they dribbled it around so that there was practically nothing for the operation of each station. They could accomplish but little under such a handicap. Eventually the commissioners secured the approval of the legislature to close a number of the hatcheries. With the same appropriation, they were then enabled to secure a much larger output. I think Vermont, and probably some of the other states, have had a similar experience. State hatcheries are recognized as being a political plum. Each legislator thinks if he can bring home a fish hatchery for his section he has fulfilled his duty toward his locality and his constituents.

Mr. R. K. Robinson, White Sulphur Springs, W. Va.: I would like to ask Professor Dyche if he considers an eight-inch pipe sufficiently large for drawing down the ponds when he desires to draw them down rather quickly?

Professor Dyche: The drain pipes will connect with the deepest part of each pond and any pond can be drained in from 24 to 36 hours.

Mr. Robinson: Do you consider that quick enough?

Professor Dyche: Yes. As a rule we do not care to run the water out in such a short time, particularly if the pond has a good growth of vegetation for the young fish to hide in. The fish must be looked after. I have not seen many ponds at other hatcheries that could be drained very quickly. All the water can be drained from these ponds. Most of them have two supply pipes and can be filled much quicker than emptied.

NOTES ON THE FISH OF THE CUMBERLAND RIVER

By J. F. Boepple

While examining the Cumberland River during the summers of 1910 and 1911, from its headwaters to its mouth, for information as to the mussel beds, I devoted some time to observations relative to fish.

Among the largest yellow catfish I saw caught was one weighing 59 pounds. The largest buffalo weighed 16 pounds, while the largest haul I saw made in the trap baskets was 58 pounds. A very reliable fisherman claims he raised some baskets of 100 pounds, and all channel cat, which they call "fiddlers" there, and the largest of which weighed 2 pounds. Drumfish, for which they use trot lines, were also conspicuous in the catch.

I found a great many people fishing with dynamite, and one of the first things I heard was complaint on the part of the fishermen against this method of fishing. A farmer at whose house I stopped told me that the week previous dynamite had been used that resulted in killing a catfish of 64 pounds. He gave me to understand that he knew these people, but dared not say anything for fear of damage to his property.

While working up the river bottom for mussels, I found places where there was no life of any kind—no insects or worms, and upon inquiring among the fishermen learned that dynamiting had been done. It appears that not only the fish are killed, but all life in these eddies is destroyed, and I was informed by the fishermen that for a long time after dynamiting no fish are caught.

I was working three months on a portion of the river which was locked and dammed, some places for one year, other places for three years, and some even for seven years. The opinion of all fishermen that I talked with was that fishing was much better since the system of lock and dam had been placed.

Means should be found to stop the dynamiting of fish. The damage is too great.

SOME OBSERVATIONS ON SUNFISH CULTURE

By J. J. Stranahan

The bluegill sunfish of the north, erroneously known as the bream in the south, is, in the opinion of the writer, the fish par excellence for pond culture, particularly for the pond of the farmer or planter. In fact, in the light of recent developments, it might be predicted with a reasonable assurance of fulfillment, that even the urban resident with a fish pond in his door yard co-extensive with his dining-room may have a mess of fresh fish of his own raising, now and then, at the same time lending beauty and interest to his surroundings with less expense than would be incurred in keeping up the same area in lawn—water, fertilizer and muscle considered. I believe that I am not very far ahead of my time in respect to reducing the high cost of living when I say that for a given amount of protein or real food value fish flesh is ahead of fowl or mammal, everything considered, including, of course, cost of production.

The sunfish, *Lepomis pallidus*, lends himself to domestication most graciously. In fact he seems and acts as if he wanted to be civilized whether we like it or not. He is comparatively free from disease, makes rapid growth when given a little care and proper food and, best of all, is of most excellent flavor and quality with only just bones enough to make us relish the two sides of delicious food that his anatomy carries with a minimum of waste. His rapid growth in popularity, taxing the fish-cultural stations to their utmost limit, attests the truth of this seemingly rather enthusiastic statement.

It has for years been considered settled that the sunfish is not cannibalistic or predaceous on its kind even to a small degree. This is a mistake, especially as applied to the young of the species. They will eat their little brothers with a relish that would indicate a highball before breakfast.

The spawning operations of this species in the southern states begin during the early part of May and continue until the latter part of September, this long period due, probably, to the fact that individual females develop their ova at different times, the males seeming always ready. It seems probable that the older and larger females spawn earlier than the smaller and younger ones, and it is apparently established that a single male will occupy the same bed continuously for weeks and even months, accommodating several females during the time.

The writer took up experimental work with the sunfish, in 1909, too late to accomplish much, having been engaged earlier in the season in the study of the speckled catfish (*Ameiurus nebulosus*), which is generally called the marbled catfish in the north, where it is clouded or marbled. It was soon discovered that the late-hatched individual sunfish of the year before were preying on the young recently hatched. All of these yearlings, and there were but few of them in each pond, were immediately removed and close watch kept on the larger ones of the current year's hatch. It was then discovered that these were about as destructive as the yearlings. At least they were watching for and devouring these of the late hatch, as very reasonably was to be expected, for they were about a quarter of an inch long and no larger than most of the animalculæ on which the larger fish were feeding when they could find them.

Many experiments had been made at this station in feeding the fry and adults of the sunfish with corn mush, and with mush made with fine middlings and ground liver in many combinations. The results were always negative. The fish would take these foods for a time, say a few days, and then reject them entirely. At the opening of this season the writer was looking about for some food that might offer possibilities, when finally there was received a sample of so-called "Prepared Fish Food" from a firm at the stockyards in Chicago. It was a fine dry meal of yellowish brown color and, judged by appearances, made from fresh meat scrap. This sample was tried and a larger one requested and tried and finally a sack of 100 pounds was ordered. The food was tried out on fry and adults of the various species on the grounds with most gratifying results, even the small-mouth black bass, rock bass, catfish, etc., all taking it with much relish and thriving on it so far as we know up to the time of writing. Of course our greatest success was with the fry of the sunfish for the reason that we had them in greater numbers and because we were bending every effort to make a success of their production on a large scale.

This food is about like fine corn meal and about as free from lumps. It mixes readily with water and after being so mixed sinks slowly to the bottom of the ponds, thus giving the fry time to collect it. We have tried two sacks of a coarser grade, about like grits, which is probably better for the fingerlings, but it is not so desirable for the fry and does not form into a tenacious dough for feeding adults as well as the finer grade.

Our mode of feeding with this prepared food is to put a pint or two into a wide shallow pail or pan, adding a pint of water on one side and mixing in enough feed to make a thin gruel. This we take into the hollow of the hand formed into a cup and cast it over the surface of the water much in the manner that a farmer would sow grain, taking two or three steps between each cast so as to have them lap a little, thus making an even distribution and preventing waste. More water is added to the mixture every few rods, and the aim is to get the food to the fish as soon as possible after the water is added in order to avoid dissolving the albuminoids, which must constitute a considerable portion of the food constituents of the material.

We began feeding twice a day, morning and evening, but later decided that this was not enough and added a noonday ration with the small fish and fry, especially those in the fry ponds, and I am now of the opinion that where the best results are desired the feeding should be resorted to four or five times a day, using no more feed but giving it a better distribution and the little fish a better chance to keep themselves well filled.

We have experimented with syringes and spray pumps, but with negative results. The main objection to them is that the feed has to stay too long in the water and it thus loses much of its food value. We have also tried casting the dry meal on the water and when the wind is favorable and light this is not a bad method, for the food sinks slower and gives the fry a longer time to secure it. But if there is much wind, especially if it is freaky, this plan does not work so well for reasons which will be obvious to the reader.

By the use of this food and the system by which it is being administered, the output of this station in sunfish for the first three months of the fiscal year has trebled that of any previous whole year. What the final results will be can only be guessed at, but it looks most encouraging at this writing.

These rapidly grown fish, almost large enough for the skillet when three months old, are not, as some might suppose, tender and hard to handle. They are strong, vigorous and stand shipment during July and August of this record-breaking year with practically no loss, calling forth favorable comment wherever they have been sent. That this mode of feeding is a complete success with the sunfish there can be no doubt, but "what about the other species?" may be asked.

The season was too far advanced for any extended experiments with the black bass, rock bass or catfishes, but what little could be done gives us great encouragement and we predict that it will be just as successful when worked out with them as it has been with the sunfish. Fortunately we had one brood of late-hatched large-mouth bass on which we could do a little experimenting and later we found a very small brood which had been abandoned by the parent fish. These we removed to a fry pond, the date being August 4. The fry were not counted but were estimated at

1,000 or less, probably about 800. In the former case the parent fish had his brood near shore. They were very small, not having been off the bed more than two or three days, and the school was in compact form. Some of the new fish food was scattered over a small area, probably not over two feet across, embracing a small tuft of weeds. The whole was within a few feet of the bank so as to be well observed. The fry swam about the area referred to as long as fresh meal was put out at frequent intervals, in spite of the frantic efforts of the parent fish to get them away into deep water. They were so small that they could not be seen in the very act of taking the food, but there was no question as to the fact that they were doing so.

The case of the other brood is far more instructive and closer to the point of fish culture. Numerous exhaustive experiments have been made at this station by the writer in handling black bass fry in small ponds. All conceivable or attainable foods have been used, including plankton in quantities procured from adjoining wild ponds, and all with the most complete failure, as was also the result with this species under even more favorable conditions in Ohio under the auspices of the State Fish Commission. The fry in this pond have been fed nothing but the Chicago feed from the start to date, nearly two months, and although they have not made as rapid growth as was anticipated, they are, to all appearances, all there and doing well, there being no "big heads" or signs of cannibalism.

We believe that feeding can be carried on in the large ponds by locating the broods and feeding them while yet with the parent fish and that during the favorable weather broods can be taken out and put into the fry ponds, there to be held in readiness for shipment. We have often been delayed days and even weeks in making shipments owing to high winds and rain when, of course, broods cannot be located in the large ponds and are, therefore, often broken up and scattered about the pond to pursue their predatory instincts on their little brothers.

It takes, so they say, more than one swallow to make a spring, and we all know that some of our fondest fish-cultural hopes are ruthlessly shattered. But the writer wishes to go on record as predicting that this new food and mode of feeding will increase the output of bass in near future years as greatly as it has the sunfishes at this station this season, and that it will be equally effective on all the other species under cultivation here.

AS TO THE CARP

By W. T. Hunt

Just a word as to the humble and much-derided carp, out of my own experience with that fish, which, if more generally understood, would not be the subject of so much unjust criticism. The carp, especially fish of ten or more pounds in weight, will give the man who fishes for it with rather light tackle all the sport he desires, but its action when hooked is peculiar to itself and unlike that of any fish of my acquaintance. I have captured hundreds of large ones with an ordinary seven-ounce rod and light line and have enjoyed the sport.

I use a bait composed of flour and pulverized corn meal, with a small amount of sugar. First I mix one cup of flour with a similar amount of corn meal and then pour gradually over this one cup of boiling water, which thoroughly steams the mixture. When this is done I work it up by kneading until it is stiff and is ready for use. Sometimes I boil it for twenty minutes, but if it is properly made it will remain upon the hook without boiling. It is the best bait in this section, where the fish are plentiful in the streams. They may be taken best during the warm months.

A reel of from seventy-five to one hundred yards of strong line should be used and the rod should be fastened by driving a stiff stick between the rod and line just in front of the reel. I use pieces of rod from steel-handled umbrellas. This precaution should always be taken for the reason that if a big carp, say over ten pounds, takes the bait, it usually gives no warning but will go off in a steady pull for many yards and if the rod is loose upon the ground it goes along every time. I had a rod taken when it lay across my knees while I was mending a landing net, and I recovered it only after doing some lively swimming and diving. This carp weighed but eight pounds.

After its first rush the fish usually comes to the surface, but almost immediately goes off again and just as rapidly, with a steady pull which is almost impossible to stop. This it will repeat several times, after which it will come directly to the bank, usually at the top of the water, and sometimes upon its side. Reaching the bank, if the angler permits it to do so, it will lie with its head almost out of water and this is one of its fine tricks. Apparently it is ready to be pulled out "like an old boot," as is expressed by men who do not know, but the instant a move is made to secure it there is a tremendous splash, the tail of the fish strikes the bank and the chances are that something breaks and the man with the rod wonders why. At this point in the game many a man will carefully lay down his rod and catch the line—another fatal error—for this seems to be just the move the carp desires and it works its game. The only thing to be done, if it is a large carp, is to keep it away from the bank and this I have done by using a piece of stick, driving the fish away as soon as it gets to the bank and gradually playing it out. A big one may be finally landed with the light tackle by simply playing it until it can make no more rushes and lies helpless at the edge of the water.

As to the claim that the carp destroys game fish by eating the young, I failed utterly to prove this by making an examination, with assistance of Benjamin Cohen, a chemist, of the stomachs of a hundred carp, all over five pounds in weight. We found roots of many kinds, wild oats, grains of corn, wheat and almost all kinds of vegetable matter that grows along the stream, but no sign of fish or meat, except earthworms and waterworms, with an occasional crayfish or helgramite.

The most peculiar circumstance noted was the presence of fresh water mussels in at least ninety per cent of the fish, which seems to me to explain the disappearance of these shellfish from many streams. In the Brandywine, from which the carp were taken, were formerly millions of mussels, while at the present time few can be found on any portion of the stream. We found in a few carp mussels which had just been taken and were still alive. Others had the shell just commencing to open, still others were wide open and the meaty portion decomposed and partly digested. In nearly all we found pieces of shells, sometimes as small as the end of a lead pencil and in others the entire shell just breaking into small fragments, showing that the digestive powers of the fish must be great and quick in their action.

In a number of the fish, all taken in a stretch a mile long, we found immense quantities of what looked like fish spawn except that it was black and in pellets about the size of small mustard seed. It was found only in fish from the same locality and we were puzzled until one day, walking along the stream in that section we saw two large carp close to the bank with their heads at the surface of the water nipping at small pods which hung from plants. We gathered some of the plants and the mystery was solved. It was a wild plant, introduced at this point along the stream only, several years before, in an attempt to establish a feeding ground for wild fowl. The attempt proved a failure, and the plants we found were a few survivals.

That a carp will live for an almost unlimited time out of water if it can secure enough moisture to sustain life was proved by an occurrence in the town of West Chester, Pa., a few seasons ago. A man had five large carp in a pond and one night a cloudburst washed away the embankment and left it dry with the exception of a small trickle of water through the mud in the centre. The next few days were dry and the mud became caked upon the surface. It was believed, of course, that the carp were gone down the small stream below to the Brandywine, but five days later a small boy discovered one of the carp in a small hole and captured it with a scoop net. Nearby he found a second. Then the bank was repaired and the two fish placed in the pond, but, to the surprise of everybody who noted the fact, there were five fish, all of large size, in the pond the next morning. That they had been there when the water left and had remained in the damp mud was conclusively proved by the fact that one of the fish showed the identical mark of one which had been among the originals and was not one captured when the two were recovered. It had lost a portion of its dorsal fin, probably eaten from it by a mink or other animal, and this mark leads me to believe that the story is absolutely correct.

On one occasion I caught a carp weighing twenty-three pounds in a dam near Hibernia, on the Brandywine, taking it about 8 a.m. Instead of placing it in the water on a string, not trusting it on account of its size, I wrapped a piece of burlap about its gills and by dampening this probably once in two hours and keeping the fish in the shade I brought it home alive at 9 p.m., placed it in a bathtub and in two minutes it had about all the water out of the tub and had leaped out itself.

So much for my experience with the humble carp, which is not so humble after all when you have had experience with it.

DISCUSSION

PROF. L. L. DYCHE, Pratt, Kan.: I have collected material and am still collecting it for a bulletin on the German carp in Kansas. I have many notes on the German carp and would like to give some of my observations: However, I will not consume time for such a discussion at present. I might say, in regard to fishing for carp, that I have a boy 11 years old who has been able to catch some fine ones out of the Ninnescah River, a stream that runs along the north side of the fish hatchery grounds. In this stream there are many fine carp, some of which weigh as much as 15 to 20 pounds. The boy can catch these carp with ordinary fish worms. They may also be caught with corn, especially where they have been baited with corn chop. Dough-balls made from flour and cornmeal were used with success. The dough for the balls was made by cooking flour and meal together in a frying pan; it was stirred well and salted. When cooked to a thick mush or paste it was ready to be made into balls. A quart of this stuff was sometimes made into balls or pills and thrown into the water, a handful at a time, to bait the carp and to teach them to eat it, then at the proper time when the same material was used on the hook, the fish would usually bite it and could be taken with little difficulty.

One day I saw some men interested in the boy and attempting to aid him in landing a fish. We learned that the young fellow had a carp on his line; it had broken the pole and the boy was in the water with the line on his arm and around his legs, and was tangled up in different ways.

The carp apparently got away two or three times, but did not get loose from the hook and line; finally the boy got the fish in his arms, went ashore and threw it on the ground. The two or three kicks he gave the carp that had lacerated him with its dorsal spine was an evident outward expression of the internal feelings of the young fisherman on that particular occasion.

Mr. Meehan: Carp fishing is becoming widespread in Pennsylvania; people are beginning to find out how to catch them, and it is becoming what they call a sporting fish. It is particularly prevalent in the Schuylkill valley and beginning to be so in the Susquehanna valley. They use as a favorite bait besides the bait suggested a half boiled potato.

Professor Dyche: That is very good.

THE DECREASE OF THE COARSE FISH AND SOME OF ITS CAUSES

By S. P. Bartlett

It may be that this subject might be considered a problematical one, to some extent, and my apprehensions for the near future may be deemed premature, but to me it seems a matter of grave importance and worthy of serious consideration, that after years of work to bring about an increase in the supply of food fishes, particularly the coarser varieties, circumstances have brought about conditions which have not only materially reduced the output but which must of necessity curtail it. The rapid decrease in the supply of carp and buffalo has been most marked. Increasing for years, the output reached its highest point in 1905 and 1906, then the gradual decrease for a while was followed by the more rapid decline during the last two years in both the Mississippi and Illinois Rivers and their tributaries, until now it seems to me that the situation presents some very unpleasant probabilities unless measures are taken to offset it.

The application of protective laws, faulty at best as they have been, acted as a partial restraint to the wholesale destruction of these fish by the market fishermen. The great danger to the output does not lie here, however, but in the natural result of the rapidly increasing reclamation of what were once waste bottom lands, overflowed by the rivers in their annual floods and formerly the homes and feeding grounds of the buffalo and carp.

The Illinois River particularly presents conditions that exist in but few states, in that it lies for almost its entire length, about 250 miles, between wide, flat bottoms, which were once covered by an almost continuous chain of lakes and ponds. These bottom lands when drained by levee systems have developed into the best farming lands, and this work has been carried on so generally and so rapidly that now but a small portion remains unclaimed. This leaves only the river itself available as a breeding ground for the fish, and while it is very productive it presents but a small area compared with the immense grounds once accessible. Under conceivable conditions there might be a question as to which would be the more profitable, the land or the water, but with conditions as they are and have been there is no doubt but that the land is the more profitable, since it can be controlled absolutely by the owner, and no question raised regarding its products, while the product of open waters under natural conditions is the property of the state until caught. This allows free fishing in the open water, and the property owner has no redress except through action for trespass, which has been a scanty protection in the many suits that have been brought from time to time. The opening of the Chicago Drainage Canal, which gave a fixed increase in the depth of the water, covered thousands of acres of land that previously were subject to cultivation. This complicated matters even more, if possible, and the only remedy for the situation was to build levee systems and reclaim the lands, if the owners were to reap any profit to themselves, and this has been done with the results to the supply of fish before explained.

Do not understand me to be in opposition to such reclamation by the owners. I am but endeavoring to show some of the causes that have led up to the present conditions, and that will ultimately result in the destruction of all the best breeding grounds of the coarse fish in this state.

There is no doubt that if the waters could be controlled in the interest of the owners the revenue to be derived from the fish would, in most cases, be greater than if the land were cultivated as farms, taking the cost of reclamation into consideration. During the past session of the Illinois General Assembly I talked with a number of owners of immense areas of water along the Illinois River, and, without exception, I think, every one of them agreed to the proposition that if their property rights were given equal protection the fishing privileges would be more profitable than farms. With one accord they were equally agreed that they could not see their way clear to maintain preserves for the benefit of the public, and as a result levees are going in wherever it is possible to establish them. As an example of the conditions regarding ownership of fishing privileges, one might cite the case of the company, composed of men from Indianapolis, Ind., who bought Thompson, Grassy and Seib Lakes above Havana, Ill. The property covers an area of thousands of acres in water and marshy lands, and was bought for a hunting and fishing preserve, but at no time have they been permitted to have control of their property, for reasons given, until now they are ready to quit, and the proposition to incorporate for a levee district is being considered. Spring Lake, seven miles long, with varying width, below Pekin, Ill., once one of the famous bass waters of the state, also affording hundreds of acres of flat ponds for the coarse fish, is now in a levee district.

These are the existing conditions, but a remedy suggests itself. There yet remain several thousand acres of water available for the purpose of breeding grounds for the coarse fishes. Thompson and allied lakes, mentioned before, might be reserved for such purpose, if they could be properly controlled and protected by government or state ownership, either by lease or purchase. Such a reservation could be open to the public for angling, under proper restrictions, and closely protected during spawning season. This would assure a constant and increasing supply of young fish for the river, and do much toward offsetting present conditions.

In our state a movement is on foot to induce the state to take over a number of such places, and an arrangement has been made to meet the owners, and endeavor to secure such options as will make possible a proposition to the legislature covering the desired measure.

One of the greatest difficulties in the way, however, is the attitude of the people in general toward the whole subject of fish propagation and distribution. Now when the game question is considered, there has been no trouble in securing all the money needed. Over $100,000 annually is made for the protection and increase of game, with game farms and preserves controlled by the state, and all of it in the interest of the sportsmen. Yet this is an interest that does not in any way affect the consumer or commercial interests. Game is protected from sale, and to be enjoyed must be the product of the hunt or gift. I am not in any sense finding fault with the protection and propagation of game. It is a magnificent measure and in this state, under Commissioner Wheeler's management, has reached the high water mark of success, being wholly self-sustaining by its business provisions. But I cannot help drawing comparisons, as to the direct value to the people generally, between that interest and the preservation to the ordinary consumer of the immense output of food represented by the fishes of the state which might be conserved for their benefit with less expenditure.

Thence, the question of securing such measures as will insure a future supply at a moderate cost to the people seems to be justified. We are now at a point in our state where we shall have to meet these contingencies quickly, if the future is to be considered at all. I presume similar conditions exist elsewhere, and while they may vary to some extent, according to environments, yet the one great fact remains everywhere: Fish are an important factor in the food supply, and to conserve them we must meet and conquer adverse conditions or find too late that neglect has proved fatal.

The decrease in the output of carp in the Illinois and Mississippi Rivers is quite sixty per cent of its highest figures, and is a serious matter, commercially and from the standpoint of home food which is furnished for the taking.

I note these points and offer them to you and others interested in such matters with a view to provoking, if possible, discussion that may result in overcoming the conditions, or at least cause attention to be drawn to them with ultimate good results. In my opinion, no greater work has ever been taken up by government or state than the conservation of natural resources, and of them all fish, it seems to me, is one of the most important.

DISCUSSION

Dr. S. P. Bartlett: The proposition advanced is a simple one and applicable, so far as I know, only to the state of Illinois, and my purpose in offering the paper at all was rather to provoke discussion and ascertain, if possible, by that discussion whether other states are situated similarly to Illinois. The Illinois River for years has been noted for its great productiveness of coarse fish. Now, when I talk about coarse fish, I mean that in 1860 the output of buffalo along that river was in the millions of pounds. In 1880 the output of buffalo along the Illinois River had been reduced to about 1,000,000 pounds. The introduction of carp sent those figures up to 22,000,000 pounds of coarse fish in 1896. In the last five years the output of carp from the Illinois River has been reduced nearly 60 per cent. Now, there is a cause for that, and that cause until lately I had attributed alone to the fact of their taking in so much of the Illinois River, which is 250 miles in length with about five to six miles bottom on both sides, practically interwoven with nice beautiful lakes for its full length. All of these lakes and all of these flat places provided excellent breeding grounds for the carp.

Within the last eight or ten years a gradual encroachment upon these breeding ponds has been made by what is known as levee districts, until probably all but about 20 per cent of that entire district is taken up in these levee districts; that is to say, they are reclaiming the land and using it for farming purposes. The reasons for that I give in my paper, but that is immaterial in getting at the point I wish to reach. The point I want to make is that within the next ten years the Illinois River, probably the greatest coarse fish producing stream in the United States today, will be practically depleted of its breeding grounds on account of the encroachment of these levee districts, which will cut them off entirely. Now what I want to plead for at the next or some future session of the legislature is that the state should own and control enough land, keeping it outside of levee districts, to make public parks or preserves for the purpose of furnishing a supply of coarse fish for the Illinois River, thus preserving what will soon be depleted. This paper is not intended to educate anybody, but simply to give the conditions now prevalent along that river, and to ascertain, if possible, whether other states of the union have such a thing as a state preserve.

We have now large bodies of water along the Illinois River that are owned practically by hunting and fishing clubs. There are half a dozen of them on which a large amount of money has been expended for the benefit of these clubs.

Under a late decision of our Supreme Court they have made all waters that can be traversed by a launch for commercial purposes, navigable streams, and on such the fishermen are at liberty to go without interference, no matter what protests there may be from the owners. In other words, the owners of that submerged land, made so by the introduction of the water from the drainage canal, which was once farmland, are prevented from reaping the benefit of the product of their waters by retaining the right to take out fish from these waters, or from disposing of the waters under lease or sale. The owners of this land in many instances have done the only thing that they could do, namely, to put their land into levee districts and in some way get their money back on their investment.

I want to know whether anywhere within the states such a thing as a state preserve or a state reservation could be named. We are going to agitate the procurement in our state, either by lease or purchase, of these tracts now lying outside of the levee districts, and make them breeding grounds for coarser fishes; and while I have said that the Illinois River is the most productive river in the United States for coarse fish, it is also the greatest bass stream in the state of Illinois, and I have attributed that, of late years, to the fact that the carp, on account of their rapid reproduction, are furnishing food for the bass. As a consequence, of course, if my argument is correct, as the carp disappear so must the bass.

I believed this was the cause of the disappearance of the carp from the Illinois River, when I had a talk with Dr. Forbes, and he gave me some information which puts new light on a great deal of the subject. He tells me that at one place on the Illinois River 350 acres, which he or his assistants had carefully measured, produced half a billion eggs; and he said that by careful daily observation and investigation it was shown that less than 2 per cent of the eggs of the carp were hatched in the year 1910, owing to the fact that they had fallen or were lying upon a decomposing mass of weeds and plants and other things of that kind and were utterly ruined, and that none of the fry in that 350 acres of land ever found its way out, but perished with the receding waters in the hot weather. That is an appalling condition of affairs to those of us on the river who have watched a large commercial interest develop and then suffer a decline. Over $1,000,000 a year has been taken out of that river in the shipment of coarse fish to the East. For several years buffalo were practically extinct, but are now becoming more plentiful.

There is one other subject I want to speak about in connection with that matter, which I hope the Committee on Resolutions will take broad grounds on and put in such shape that we can all use it with our legislatures. I have been before them for 35 years and I know the difficulties that we encounter—I refer to pollution of waters. Take our finest streams in the state of Illinois, the Rock, Fox and Kankakee Rivers, and they have become simply sewers. I made an examination of the Fox where there was once a rocky bottom. Now the bottom is covered with four or five feet of black muck, which is almost unbearable for its stench when brought to the top.

Dr. G. W. Field, Boston, Mass.: In answer to the questions of the gentleman from Illinois I might say that the state of Massachusetts has maintained Buzzards Bay for the last 15 or 20 years as a breeding place for salt water fish, in which no seining has been allowed—only hand line fishing. Buzzards Bay is 20 miles long and 215 miles wide. We have also a similar place farther down the cape, relatively of small size, where no seining is allowed.

All the state ponds of Massachusetts above 20 acres in area are fished only by a single hook and line; no seining is allowed. The same is true of the rivers. The conditions are not exactly parallel with those in Illinois, as we have only a few carp. They were introduced some years ago in Laurel Lake in the Berkshires. I understand there is but little water left in the lake and the rest is carp. The wealthy residents complain that the carp come into the gardens and pick the strawberries. (Laughter.)

Dr. Bartlett: Is it possible for me to obtain a copy of the laws bearing on that subject?

Dr. Field: I will see that you get copies.

Mr. D. B. Fearing, Newport, R. I.: I would like to tell you a carp story. I used to live in California at a place called Upper Lake, and to get there in those days, there being no railroad, one had to go by stage coach and cross the Russian River. During the spawning season of the steelhead trout I have seen anywhere from six to a dozen or more of the trout killed by the wheels of the coach and the horses' feet. The fishing was excellent in Upper Lake, and there were myriads of canvasback, redhead and wood ducks to be killed. About 25 years ago a German turned an aquarium full of carp into the lower lake, and today there is not a steelhead trout in either the upper or lower lake; there is not a wild duck to be found; there is nothing but carp.

Dr. Bartlett: I have long been abused on account of the carp. I could not come into the room but some one would shout: "Here comes old carp." A number of states enacted legislation against the introduction of carp, and their defense made me quite notorious all over the country. The carp has been wrongfully abused, and in line with what has been said I want to read you a telegram that got into the Associated Press dispatches in the Illinois papers, to show you that there are two sides to the question.

"CALLS BLACK BASS CANNIBALS

Veteran Illinois Fisherman Says That They Eat up Other Varieties

Bloomington, Ill., October 1.—Mr. Lawrence, a veteran fisherman of the Illinois River, thinks that the new fishing law has many bad points. He asserts that it is useless for fishermen who seine black bass to return them to the water, insisting that every black bass that has been gilled will die, or will be just as good as dead when it gets to the net. He enters a severe indictment against the bass, claiming that they have pronounced cannibalistic instinct, and are the most voracious destroyers of young fish and spawn on the river. As they increase under the protection of the law, the other varieties will decrease. So between the cannibals and their protection, other species will be destroyed and black bass placed in the ascendency. Mr. Lawrence says black bass were never so plentiful as on the Illinois; and the great increase is due to the thorough protection of them."

Mr. Meehan: We have a saying in Pennsylvania that it is always unsafe for anyone to say that any particular fish is very destructive and ought to be exterminated, because by so doing he is very likely to tread on the tail of his favorite fish. (Laughter.)

Mr. J. S. P. H. Wilson, Auburn, Me.: I come from the state of Maine and we boast the most beautiful waters and fish in this union. I came down here for information. Now the most important question I want to ask is this, how to keep the carp out of the state of Maine. I am afraid they may walk overland and get into our waters.

Dr. Tarleton H. Bean, Albany, N. Y.: As I understand, this is not a carp controversy, and I will not talk about carp, but I would like to say to Dr. Bartlett that on the question of what the states are doing to protect the breeding grounds of certain fish, New York has within its own forest reserves certain lakes which are absolutely protected against fishing of all kinds, and kept for breeding grounds of brook trout, lake trout, white fish, and other valuable species. There are large lakes in the Adirondacks; one is near the hatchery at Saranac Lake, and although called Little Green Lake, it is a large lake. There is also a larger Green Lake in the same region, but only one of these is reserved by the state as a breeding ground for certain kinds of fish. Then on Long Island there is Great South Bay, which, as you know, is an immense body of water, and it is almost entirely protected from fishing of all kinds except with hook and line. Great South Bay is perhaps as fine a body of water for the breeding of weakfish, scup and sea bass, as any piece of water in New York.

Then again there is a law in New York which forbids the seining of smelt in trout waters. That protects the smelt because they run up in the trout streams to cast their eggs in very shallow water. The smelt is so common that anyone can obtain a mess of it. Great South Bay has been so thoroughly restocked by natural processes that the fishing is better now than when I first spent my summers there 25 or 30 years ago. You will see that the state has various grounds which cannot be encroached upon by anyone except hook and line fishermen without incurring risk of heavy penalties. A great deal of good has been accomplished in this way. The New York law might be a good one for Dr. Bartlett.

Dr. Bartlett: I should like to have it very much.

Dr. H. B. Ward, Urbana, Ill.: I was very much struck by the remark that was made by the last speaker, Dr. Bean, in mentioning the maintenance of certain lakes in the forest reservation as preserves for the breeding of trout.

Being a New York man myself, I think perhaps I appreciate more than some of those who have always or never lived in Illinois, the peculiar character of this Illinois River. It is really a very remarkable stream. In the course of the valley, the immediate plain of the river, there are large areas of back water, cut-offs, sloughs or bayous, places which connect with the open river and yet are of an entirely different biological character. They are quiet waters with an abundant opportunity for plant growth and with splendid areas for the development of young fish. The progress of the conquest of the land leads naturally to the reclaiming of these areas. Cultivated land bordering on the river is of considerable value. An organization with financial means gets the right to control a certain part of the back water, puts up there a dyke or levee and brings the whole area under cultivation. The inevitable result of that tendency is to confine the river to a relatively narrow channel, to make of it, in other words, a canal.

By the very clear presentation which Dr. Forbes gave the matter this morning, you can see the inevitable result of the increase of pollution and the springing up of cities on the banks of a river. It becomes for large portions of its course, and during the summer season at least, a septic tank or an open sewer, if you please to call it so, where the conditions of existence are so radically changed that fish cannot maintain themselves.

Now, while other states, with a different type of land, will have in their forest preserves or elsewhere, opportunities for the breeding of fish, there is apparently only one way in which the state of Illinois can gain such opportunities, and that is through a new and untried and perhaps an unwelcome method of treatment, namely, the acquirement by the state of the right in fee simple to certain of these areas and their preservation under natural conditions. For the fish live up in these back waters, in those creeks, and the expansion of the river where the water is still pure; they live happily there when the conditions in the main river are such that they cannot maintain themselves there; and you will recall that Dr. Forbes gave examples of that this morning.

It seems like a strange thing for a state to acquire a considerable area of swamp land or of overflow land; and yet after all, gentlemen, that is directly along the line which the state follows in securing tracts of beautiful mountain or forest land; it is for the preservation of natural conditions for future generations.

The maintenance of the fish supply is of real importance to the state. It cannot be maintained if the river is narrowed down, in this case, to a plain channel through which the sweep of the sewage-contaminated water eliminates all possibilities of fish existence.

There must be set aside for the people, for the state, some of these areas of back-water land, where the natural conditions of quiet water, of plant growth and other conditions favorable for the existence of fish shall be maintained. So, strange as it may seem, the state is to be called upon to preserve for itself and for the maintenance of its fisheries and for use of its citizens a type of nature that is fast disappearing, and to maintain in perpetuity a certain part of this land unchanged in order that suitable conditions for fish existence may be afforded, and that the generations to come may see something of the wild bottom land in which the fishes now live.

While from one standpoint that appears strange, yet, to my mind, it is precisely identical with the movement which calls for the preservation of the forest and mountain areas where game of the bird type or of the mammalian type live, which will give to the citizens of the state and to subsequent generations, an opportunity whereby there can be experienced the enjoyment of the woods and mountains.

I know of nothing in other states to the eastward which is really parallel to the condition which exists in the valley of the Illinois River. I wish the members might have the opportunity to go up and down the Illinois—not to see this main channel of the river, but to have a chance to wander in a boat out into these enormous side-arms of the stream, and see the beautiful lakes that have been developed there by Nature, and the splendid opportunities that these fish have for existence.

I can say as a stranger who has recently come to the state of Illinois that it is a revelation to any man to see the character of those lakes; and there are some of them which I have been privileged to visit that are miles in length, as well as hundreds and perhaps thousands of acres in area. If at any time this Society should have the opportunity to visit one of those lakes and to see the natural conditions which still obtain there, I am sure that you would feel like joining with us of Illinois in demanding that some way or other something of that type should be preserved. (Applause.)

Dr. Bean: Just a word more. I neglected to state that New York had another resource in the shape of feeding grounds for fish, in its artificial water ways. In the fall of each year the Conservation Commission, which now includes the old Forest Fish and Game Commission, is invited to send experienced men to the vicinity of Rochester to collect fishes which have grown up in the canal, in what they call the east and west waters. The number of good fish taken that way is almost startling. It includes black bass, pike-perch, calico bass, rock bass and various other good fishes. So that in addition to its preserves the state has artificial breeding grounds for fish from which it has drawn large stores.

Mr. H. Wheeler Perce, Chicago, Ill.: Coming from Illinois, I would like to put in a plea for the assistance of this Society in bringing about the conditions Dr. Bartlett referred to, which are much desired by those of us in Illinois acquainted with the situation and advocating fish conservation.

It would seem to me at a casual glance, that a knowledge of any enactment of any state setting aside for the permanent use of the state some particular section of land, whether it be mountain land, water land, prairie land or forest land, would help us in any efforts that we may make for the preservation of this section of the country spoken of by Dr. Bartlett. Surely some members of this Society can aid us materially by advising of what has been accomplished, and in what manner, in their own state or locality.

MR. E. T. GRETHER, St. Louis, Mo.: In regard to Missouri taking part in setting aside a tract of land, regularly every two years we have a political fight over our game and fish laws, and we have to battle pro and con to keep our laws on the books. At the last session of the legislature, to give additional interest to the matter, we attempted to purchase 11½ square miles of land in a most beautiful place 30 miles from a railroad, and having a number of fine improvements in the form of buildings, one of them with 60 rooms worth over $100,000, and another one used as a garage valued at about $10,000, there being about $160,000 already in improvements on that property. In this 11½ acres is a wonderful tract of natural scenic beauty, with caves and subterranean passages, lakes, waterfalls, rocks, etc., a vast amphitheatre, with natural caves, bridges, etc., a good trout stream and bass streams. We wanted to have it set aside as a state park, and we thought in addition to doing so conditions were such that we could buy the tract for $160,000. We found we could. We had a surplus in the fund of about $45,000 at the beginning of the year when the legislature was in session. We thought if we could buy it we would interest the people of the state in it for a summer resort, for bungalows, also for fish and game improvement and interest the sportsmen. We would also put aside a sum of money annually out of our game fund and commit the state to the purchase of that tract, thus perpetrating the hunting license feature of our game and fish laws, which has always been attacked by a retrogressive element in the state legislature. By making the first small payment the state would have been committed to a policy of revenues now in vogue, and also prevent the excess collections, above game warden salaries, etc., from being diverted to other purposes than for which it was collected. By making only a small payment the property would be secured.

We came within one vote of purchasing that tract and we expect to try again. We want to use it as a place where we can raise game and fish, not so much to allow people to kill game, but to see the varieties of game in a natural state, and for fishing opportunities for a great number of people. The improvements on the ground in the way of buildings, pumping station, etc., are worth more than the price of the land itself. We argued and sent pictures to show the beautiful scenery, and we had assurance from one of the railroads that they would build in as soon as the state took charge. A wealthy gentleman had purchased the land, but he was killed in an automobile accident, and the property is now for sale. The nature of the country is such that sitting high on the rocks and cliffs it is almost like a view of Switzerland. We tried and fought just as hard as we could to accomplish our desires, and we have tried to give them good service in our game and fish department here, but we still have strong opposition. I want to congratulate Professor Dyche on the success of the work which he does before the Kansas Legislature, but we have more trouble in our state. Every two years I have been one of several persons that go before the legislature and have a regular fight; various interests represented there have even fought our plan. If we had carried it through, we would have had something as fine as anything in Colorado. A great many of our people do not know about it. For the benefit of Dr. Bartlett I will say that it is one of the things that Missouri tried in the way of setting aside land to aid in our work, but failed on by one vote.

THE DISTRIBUTION AND FREQUENCE OF ANIMAL PARASITES AND PARASITIC DISEASES IN NORTH AMERICAN FRESH-WATER FISH.*

By Henry B. Ward

In his valuable work on fish diseases, Hofer (1906) distinguishes two types of general infectious diseases: those caused by bacteria and those produced by Sporozoa. Special diseases of individual organs he classifies as due to mechanical causes, to chemical influences, to disturbances of nutrition, and as parasitic diseases either of plant or animal origin. Under the last heading—parasitic diseases of particular organs due to animal parasites—he differentiates further those due to Protozoa, to worms, and to crustacea of various sorts, noting the occurrence of several hundred different animal parasites in European fish and recording more than one hundred specific diseases which are due to their action. This work is of great value both to the practical fish culturist and to the scientific student. It stands, however, alone as a general work in this field and the only information available in English consists of widely scattered notes in works on other topics or of brief special papers published in journals often generally inaccessible. In either case it is difficult to trace these items and still more difficult to secure them, so that usually one is unable to make any use of the material they contain.

Two years ago Dr. T. H. Bean read before this Society a paper entitled, "A Plea for the Systematic Study of Fish Diseases." He emphasized our scanty knowledge of the cause and treatment of fish diseases and the inadequate allotment for scientific inquiry in such lines compared to the economic value of the researches. He added a brief and

*Contributions from the Zoological Laboratory of the University of Illinois, No. 13.

confessedly incomplete bibliography on the subject with most valuable abstracts of the more general and extensive articles. This bibliography covers all types of diseases, including such as are of unknown origin as well as those due to plant and to animal parasites. We are certainly indebted to Dr. Bean for calling attention forcibly to the needs in this field, and for one, I resolved at once to do what I could toward remedying the defect in the particular line with which I was familiar. With this end in view I have brought together all records of parasites in North American fresh-water fishes that have been published up to date, and have added records of my own observations taken from field notes. With these I have included records of material obtained by various other investigators who have been kind enough to place their collections at my disposal from time to time. Some collections were not large, others were of considerable size. All were alike valuable in furnishing evidence as to the abundance and range of various parasites, the host species infested, and seasonal or other factors that influence their occurrence and importance.

Among the important fish diseases are those which have been ascertained to be due to parasitic organisms. These are of two types: 1. Diseases which are caused by the invasion of plant parasites such as fungus, moulds, and bacteria. 2. Such as are attributable to animal parasites. The latter are of relatively recent discovery. In most cases they are as yet imperfectly known and their number will doubtless be considerably augmented with the progress of knowledge in this field. Through study diseases of unknown origin are being traced to definite causes, and in the majority of instances the cause is found to be a plant or animal parasite.

While the part of the lower plants in producing disease has long been known, the corresponding rôle of animal organisms is a subject of relatively recent consideration. Consequently it may be valuable to outline very briefly the recognized ways in which animals may be related to the cause and spread of disease. (For a fuller discussion consult Ward, 1905; see list at the close of this paper.)

Animals may be merely mechanical carriers of disease transporting the causal organisms from one point to another, as flies transport typhoid germs or eggs of parasitic worms. They may be breeders of disease when the germs go through processes of multiplication within the body of the carrier and the number of infecting organisms is greatly increased thereby. This is the case with the germs of malaria, which multiply in the body of the mosquito. In this instance the latter is an essential condition for the spread of the disease; it is hence a breeder as well as a transmitter of disease. Finally animal organisms may be definite producers of disease; and many among the various types of animal parasites belong in this class.

To comprehend rightly the standing of parasites as disease-producers, it is necessary to review briefly the effects which the parasite exerts on its host. Here again the limits of the occasion demand extreme conciseness and I may refer those especially interested to a more extended discussion of the topic which I have published elsewhere (Ward, 1907).

Among the vertebrates, the only instance of a species which definitely causes disease is that of the lamprey. Its well known action on the outside of the body is distinctly analogous to that of the hookworm in the intestines. Usually disease-producing animals are small or at least gain access to the body of the host in a stage of development which is insignificant in size. Among the Crustacea and Insecta one finds some groups highly modified to adapt them to external parasitism and certain of these will demand attention later in this paper; there are, however, only a few of them that are internal parasites. The worms furnish some ectoparasites on water-living hosts and a large number of endoparasites which infest all types of animals and produce many serious diseases. But in the group of minute single-celled animals, the Protozoa, are found the most numerous and most serious disease-producers. The effects they produce are as varied as the species which produce them. In one respect only do they differ from the higher parasites. They have usually the power of multiplying within the host animal, a power which most higher parasites do not possess, and accordingly, even though the original infection be inconsiderable, the number of parasites may increase beyond the ability of the host to resist their attacks. The Protozoa include thus the most dangerous animal parasites.

The effects of the parasite on the host may be classified roughly as mechanical, structural, or functional. Purely mechanical injuries, such as the stoppage of the alimentary canal or any other passage way, pressure of the parasite on important tissues, the irritation of delicate structures by movement or the distortion of organs, though found among fishes, are nevertheless rare and of distinctly secondary importance. Hofer mentions a number of such cases in European fish, and notes their rarity. Similar troubles doubtless occur among fish in our own waters, but their infrequence renders them of little practical importance and I have been unable to find any mention of them in the literature.

Structural changes, such as the proliferation of muscle, or other cells, are frequently produced by the protozoan parasites. The importance of parasitic invasion is here clearly related to the numbers and size of the parasites, and in most cases the action of a few is insignificant, whereas the influence of a greater number or of such as may be relatively large is a serious factor in the economy of the fish. The location of the parasite is also important, and most serious effects are produced by insignificant organisms in the nervous system or other delicate or important structures. All of these features are as yet relatively unstudied in the case of fish parasites. Even in Europe where investigations have been more extended because the culture of fishes has been pursued as a commercial undertaking for more than a century, observations on these points are scanty and unsatisfactory, while in this country the only references consist of meager notes, scattered through a mass of other material. There is no doubt that special diseases exist, but we know next to nothing of their distribution or of their frequency. So far as methods for the relief of the difficulty are concerned the American fish culturists may follow with safety the processes already worked out in the old world.

Giard was the first to discuss a widespread phenomenon of biological importance, which he named parasitic castration. This is of most frequent occurrence among invertebrates, especially Crustacea; it consists in the reduction and ultimate destruction of the reproductive power in consequence of parasitic invasion. The effect is produced directly or indirectly; in the one case by the actual destruction of the sexual glands and in the other by the subtraction of so much nourishment that these glands remain in an undeveloped condition and are not functional. The condition has not been reported previously from fishes, but is, I think, not an uncommon occurrence. At least I have examined fish of several species in which the sexual glands were atrophied as the evident results of large parasitic infestation. One of these was a rainbow trout sent me from a hatchery. This condition deserves careful attention, as the effect is evidently serious in fish culture since it attacks the very element in the fish which is of supreme importance to the fish culturist, viz, the reproductive power.

One further fact deserves especial mention. The effects produced by parasites have been determined by a study of the conditions in higher animals. Economic reasons have limited the study almost entirely to man and the important domestic animals. For the water-living animals one can find no regular, systematic, or extended studies. The casual notes of investigators occupied with other problems yield all the definite information at our command. Beyond this dependence must be placed on inferences from known conditions in higher groups. It is evident without further discussion that this is at best an unstable foundation on which to erect so important a structure.

Our knowledge concerning the parasites of fresh-water fish in North America is due first of all to the researches of Dr. Joseph Leidy, a former distinguished physician and naturalist of Philadelphia, who studied and recorded the occurrence of many species from American fish. It is said of him that he was accustomed to visit regularly the local fish market in search of parasites and the discovery of a new or unusual form was a constant source of pleasure. His contributions are numerous and valuable and his collection is the most extensive yet on record in this country. It has been listed by Stiles and Hassall (1894).

The records of Verrill cover chiefly the parasites of marine fishes, and those of Linton are largely the same although the latter has published several very important papers on the parasites of fresh-water fishes; these are duly entered and annotated in the appended bibliography. Ramsey Wright, Stiles and Hassall, Pratt, and Calkins have also contributed important articles on this topic which, with others of perhaps equal importance though more limited in extent, are all included in the bibliography. From the standpoint of the fish culturist the papers by Bean, Clark and Marsh, among others, are deserving of especial mention. Though embracing many titles the bibliography is probably incomplete, even for the limited field it attempts to cover.

The simplest of animal organisms are the single-celled forms or Protozoa. Among these there are three groups, the Sporozoa, the Flagellata, and the Ciliata, which furnish disease-producing organisms harmful to the fishes. Undoubtedly the most important are the Sporozoa, which invoke general diseases of frequent occurrence and serious in effect. These organisms reproduce with extreme rapidity, giving rise to a mass of individual parasites that invade the different organs and tissues of the fish, bringing about changes in various structures that ultimately endanger the life of the host.

Among the various groups of Sporozoa the Myxosporidia are peculiarly characteristic fish parasites. Many of them occur generally throughout the organs of the fish, although others confine their attacks to special organs or systems. These forms affect chiefly the skin of the fish, yet are commonly found in the gills, forming numerous nodules on the gill filaments. Other species inhabit the intestine or liver, and give rise to general epidemics of the most serious type. Two species among these, *Myxobolus cyprini* and *Myxobolus pfeifferi*, give rise to two of the best known and most dangerous fish epidemics of Europe: the carp pox and the catfish boil diseases. Of a similar character is the nodular disease of minnow and stickleback.

In 1894 Gurley published an extensive monograph on the psorosperms of fishes, in which he listed, from various parts of the world, 70 valid species and 26 doubtful forms. These were obtained from 76 lost species. Only 9 species are listed from North America and but 7 of these come from freshwater fishes. Exceedingly valuable tables on distribution and systematic keys make the work generally useful. Of North American species he says that *Myxobolus oblongus* Gurley from the chub-sucker is numerous on fish from Mississippi and rare on those from other localities. *M. globosus* was found on the same host from North and South Carolina and from Mississippi. *M. transovalis* was present rarely on shiners from Virginia. *M. monurus* occurred on the pikeperch from New Jersey and *M. macrurus* on a Texas minnow. *M. linearis* was collected on the bullhead from Iowa. This brief list shows at once a wide range both of localities and hosts for the few parasitic species. These forms are; however, not so rare here as this record would seem to indicate. In conversation with various persons, I have learned that such parasites are frequently met with, and in one case at least have produced an epidemic at a hatchery. Unfortunately it was impossible to secure material for study and determination as the time had gone by and the species present must remain undetermined. That other yet undescribed species exist in this country, I cannot doubt, in view of my own experience. In several cases I have seen infections of *Myxosporidia* which could not be identified as known species. These forms should receive careful attention with a view to determining fully the species present in this country, together with their frequence, their range, and the factors which determine their occasional serious increase in numbers.

A related form which also belongs in this subdivision is the organism that produces an epidemic among brook trout, *Lymphosporidium truttæ*. The minute spores are found in all organs, and sharply limited deep ulcers appear on the fish and extend into the internal organs. These epidemics are extremely fatal among brook trout of all ages. The parasite has been carefully studied by Calkins, who inclines to the view that the fish may not be its original host, as similar organisms are found in the body cavity of various small Crustacea and the trout become infected by swallowing such Crustacea containing the Protozoa. The method recommended for handling this disease includes the destruction of diseased fish, the draining of infected ponds, and their exposure to the sun. If interbreeding of diseased fish is avoided and the water kept clear and cool as well as other means taken to sustain the vitality of the fish and prevent deterioration through inbreeding, the disease can be kept under. Marsh has recommended that the fish culturist avoid over-crowding and transfer diseased fish to larger quarters with more rapid flow of water. The disinfection of ponds by chloride of lime or copper sulphate appears to be of value.

Among the flagellate protozoans there are only two forms which call for more than passing consideration. The species known as *Costia necatrix* produces a serious and well-characterized disease among trout, goldfish, and other aquarium inhabitants. The skin of the fish loses color and becomes cloudy in spots. This effect is due to the assemblage at the surface of an enormous number of the microscopic flagellates. They are usually anchored to the skin by their long flagella. Treatment of the fish with two per cent salt solution for one-half an hour results in the destruction of the parasite and the cure of the disease. Other flagellate Protozoa belonging to the group commonly designated as trypanosomes are known to occur rather commonly in the blood of European fish; thus far observations have not been made on the occurrence of these forms in North America, nor do we know much concerning their abundance or importance even in Europe. Other forms of this group are the cause of serious and widespread epidemics among domesticated animals in various parts of the world. One would readily infer that parasites of this type in fish may exercise a similar destructive influence on their host.

The most widely distributed and most dangerous disease caused by ciliate Protozoa is due to *Ichthiopthirius*. Well known and feared in the old world for its ravages among fish in aquaria, in breeding tanks, and even in fish ponds, it occurs also in North America. At the World's Columbian Exposition in Chicago, in 1893, it attacked the fish in the Fisheries exhibit and did considerable damage. Because of the descriptions published in connection with that epidemic it is fairly well known in this country. The parasite is a minute oval body which when young bores into the skin of the fish and produces there a small pustule in which it lives on the degenerated dermal cells and after reaching full development forms a cyst and falls out. In a brief period hundreds and even thousands of such minute bladders and the resulting tiny orifices cover the skin of the fish until it is destroyed and the fish succumbs to the disease. Means of cure have not yet been successfully introduced and prevention is the only effective protection.

Skin infections due to other species of ciliate Protozoa are known in Europe to attack carp, goldfish, eels, and trout. They are prominent in fish confined in aquaria, or in small basins, if not exclusively limited to such conditions. In particular among goldfish these attacks become epidemics of the most serious character. Careful investigations are needed to determine whether somewhat similar epidemics popularly reported in this country are caused by the same or related parasites.

Among the parasitic worms three types occur in fish: The Trematoda or flukes, the Cestoda or tapeworms, and the Nematoda, roundworms or threadworms. A few of the flukes are found living on the skin of fish as external parasites, but these are confined to marine species and deserve only passing mention here. All the rest of the forms mentioned which are parasitic in fish occur within the body and are regarded as internal parasites, even though some of them on the mouth or on the gills have practically the same conditions of existence as are found on the external surface and are very similar in structure to the species of external parasites that live on the skin of marine fish.

A few of these internal parasites live in the body cavity and come to notice when the fish are cleaned, a few others occur embedded in muscle tissue or at other points and are sufficiently conspicuous to attract attention at that time or later, but the large majority of such forms inhabit the alimentary canal, liver, swimming bladder, or other visceral organs. They are removed in toto with the viscera and only rarely are recognized as present. They are nevertheless the most important forms both from the hygienic and from the economic standpoint.

Where only a few internal parasites are present their influence on the fish is relatively unimportant except in so far as they form the basis for an infection which under favorable circumstances may increase to far greater proportions. The breaking out of parasitic epidemics is well known and is justly regarded with apprehension, for both among wild fish and among such as are held in control, such epidemics have appeared suddenly and in a brief period have swept away the results of years of labor on the part of the fish culturist. But even where no epidemic breaks out there is a distinct loss, since the influence of parasites reduces the reproductive power of the fish and also its power to grow and to lay on flesh. Now these are precisely the factors in the biology of the fish which are of the greatest commercial importance and hence even in the ordinary case a mild parasitic infection is costly. When one adds the possibility that at any moment a serious epidemic may break out it is apparent how important is a knowledge of the degree of parasitic infection, of the means by which this infection is spread, and of the methods by which it may be reduced.

So far as man is concerned almost all of these parasites are harmless—*i. e.,* they do not have the power, even if transported in a living condition to the human alimentary canal, to establish themselves there. As the viscera are removed before the fish is cooked, smoked, salted, or otherwise prepared, such a transfer is possible only when the parasites are encysted in the flesh or are found in the body cavity. In the case of the eggs used in making caviar, such parasites as were not destroyed by the method of preparation would be carried into the human intestine and bring about an infection. The only important parasite undoubtedly transferred to man in the flesh or among the ova of the fish is the larva of the fish or broad tapeworm, *Dibothriocephalus latus.* Infection by this species is very common in some fish-eating people of Europe but, though known, is very rare in America. Cooking destroys the life of this parasite but salting and smoking do not always do so.

For some time I have been studying the parasitic worms of fish and have accumulated data looking toward the solution of their questions. At the time of making the first collections I published a brief note (Ward, 1894c) on this topic. Now in the light of more abundant evidence it is possible to speak with greater definiteness on the subject.

All of the records utilized here were taken from collections made by me or under my direction and great care has been exercised to reach the maximum accuracy. They relate to fresh-water fish or to such migrants as spend a portion of their existence in fresh water. In all, the records cover 991 fish belonging to 62 species. Only 179 fish were uninfected. (Table, p. 226 and 227.)

In general, then, very few fish are free from internal parasites. The lightest infection is found in the carp, an introduced species, and in the minnows and other small stream fish. In the carp, which was introduced in the egg stage, it is natural that the number of parasites should be smaller than usual in fish of similar types and far smaller than characterizes the same species in its home in continental Europe. It has here only the parasites of American origin that could secondarily adapt themselves to its habits and the brief time since its introduction has not been adequate for the acquirement of an extensive parasitic population. Only an occasional individual of this species is at all affected by internal parasites. Among the fish of small streams the conditions are unfavorable for infection. The territory is limited, unconnected with other regions, constantly drained of its organisms, and parasitic forms are not likely to gain a footing. But because of its limitations it is easy to see that when parasites are once introduced the infection is likely to be heavy. It would be expected, then, that the records would show either that parasites were absent or were abundant, and furthermore that this difference was associated with definite regions. The evidence, while perhaps not conclusive, clearly indicates the conditions noted. In all, ten fish among those examined failed to yield any evidence of parasitic invasion.

On the other hand there are not many fish in which the infection appears excessive. The tables show at a glance the extent of infection, which can be taken from the column indicating the average infection. One possible difficulty must be avoided in making such a comparison. The numbers do not indicate the relative size of the parasite, which is an important factor in the effect produced. Especially among the cestodes, or tapeworms, is this difference of importance, as some species are very small and others conspicuous by their size. A dozen of the latter will be of greater influence on the host than a thousand of the minute varieties.

From these tables it appears that on the whole the migrating fishes are more heavily infected than those which are confined to fresh water during their entire existence. This is conspicuously true of the Alaska salmon. In addition to the migratory fish one will pick out from the tables many rapacious species as almost or fully equally infected. Such are the lake trout, whitefish, black bass, rock bass, pike, gar, dogfish (*Amia*), bullhead and some other catfishes, wall-eye, and perch, in which practically every individual was infected. That the degree of infection is clearly related to food and habits of life is evident from an examination of the table (p. 226 and 227) in which the fish are grouped by families. In the families of the catfishes (Siluridæ), gars (Lepisosteidæ), salmon (Salmonidæ), and pikes (Luciidæ), infection is almost universally recorded. Among the sunfishes (Centrarchidæ) the only exception is the smallest, the common sunfish; among the perches (Percidæ), the small darters again are the exceptions. On the other hand the stickleback, miller's thumb and mooneye are infected in only about half the total cases, while among the cyprinid fishes infection is distinctly unusual. A few types are represented by so few specimens that no conclusions can be legitimately drawn concerning conditions in the family of the species.

Regarding different types of internal parasites the tables disclose some interesting and important conditions. Few fishes shelter equal numbers of all kinds of parasites and no species is recorded as heavily infected with all four groups of intestinal worms. Only one,* the trout of the Great Lakes, is credited with an abundance of three kinds—tapeworms, roundworms and spiny-headed worms; and, strangely, this is almost the only fish listed, and it is the

*The Pacific salmon are all of them well infected by flukes and tapeworms, while some of them, the king coho and red salmon, harbor a generous supply of roundworms also. But, as already remarked, these have brought their parasitic guests with them from the ocean and can hardly be compared justly with fish limited in range to fresh water exclusively.

only member of its family, in which flukes were not found. This is all the more striking in that flukes are abundant in more fish shown in the table than most other types of parasites, being markedly so in fourteen fish listed, as against sixteen records of marked abundance in a given host species for tapeworms, 7 for roundworms and 8 for spiny-headed worms. In the catfishes the only very abundant group of parasites is the flukes and that occurs in extra measure in a single species, while other types of parasites are distinctly infrequent. In this same group of the catfishes, however, very few fish were found to be free from parasites, indicating thus a steady infection but of low rate. On the other hand the sunfishes illustrate an irregular, casual infection, often becoming strikingly large. An inspection of the table for this group shows that most individuals do not shelter any trematodes, but those that do are relatively heavily infected. The frequency of infection in a given host is indicated by a comparison of the number of hosts infected with the number free, and the degree of the infection is shown by the average number of parasites present in those hosts that are infected. Finally the extreme number of any type of parasite found in a single individual is some indication of the possibility of extreme infection. Thus only one steelhead was infected with trematodes but that one sheltered 142 of these parasites; and one bluefin whitefish contained 303 tapeworms. Numerous similar instances occur in the sunfish family, where half or more of the individuals were free from one or more types of parasite and heavily infected with some other parasitic form which in turn was absent in the next fish examined. Among the perches also parasitic invasion was usually very light, but in a few cases distinctly heavy. These as well as other interesting relations appear on examination of the data given.

It is important to call attention to the necessity of care in interpreting the figures found in the table. On the face of the data given there the stickleback was not heavily infected, since one-third of the total number of fish recorded were free from any parasitic invasion and the average infection was only three worms—one cestode and two nematodes. Yet in comparison with the size and reserve energy of the host the infection was excessive, especially as the single cestode, parasitic in the body cavity, distended the body to an extreme limit. There was in fact at this point and time a virtual epidemic among the sticklebacks and we picked up daily considerable numbers of dead and dying fish at the surface of the water and along the shore.

After having concluded thus a study of general conditions we must also consider the special relations, since not all parasites are of equal importance to the fish or to the fish culturist.

There are no general diseases produced by internal parasitic worms unless general weakness, loss of flesh and of power of growth and reproduction be considered such. The parasites are located in special places and usually produce very definite effects. Nodules on the skin and in the gill filaments are due to small encysted trematodes. Such a species in black bass, pike, sunfish and perch is described by Osborn (1911). Some free trematodes also live on the gills and in the mouth cavity.

In the intestinal canal of fish Hofer records from Europe 49 different types of trematodes, 44 distinct tapeworms and 65 roundworms, and the number has been considerably increased by the studies of recent years. The number reported from North America is difficult to determine exactly, though certainly much smaller. I estimate it to be about half as great, but the reported forms are apparently much fewer than those which are still unreported.

Trematodes occur frequently in the eye of fish in Europe, causing blindness. While infrequent in nature this trouble becomes common at times in fish ponds, not only destroying the eye but being followed by the death of the fish. The cause is found in minute larvæ of certain flukes which in the adult condition live in water birds.

The cestodes are in general far larger than trematodes and play accordingly a more important rôle. They live in the intestine, in the pyloric appendages, or cæca, or even in the body cavity. One finds them often in such size and numbers that the cavity of the canal appears to be stuffed full and the intestinal wall is markedly distended by their bodies. In such cases the effect of their presence has been noted by many observers in the greatly emaciated body of the fish. The most frequent types of such worms are the Ichthyotæniadæ and the Bothriocephalidæ. An extensive monograph on the former family has been completed by one of my students and is to be published within the year. His preliminary record of the forms discovered has already appeared (La Rue, 1911).

In the body cavity other species of tapeworms are to be found in certain fresh-water fish. Linton has worked out the life history of one such species, *Dibothrium cordiceps,* which occurs in the trout of Yellowstone Lake, and is so abundant that it prevents the use of these fish for food, except by the pelicans that fish there and in return for their labor secure not only a meal of trout but also a good supply of tapeworms. Similar parasites, known as *Ligula*, are found in fish of the carp tribe in Europe and lead to the death of many of their hosts. Another form, *Schistocephalus dimorphus*, occurs frequently in the body cavity of the European stickleback and at times destroys great numbers of these fish. I have myself observed at Loring, Alaska, an epidemic among the sticklebacks which was caused by a tapeworm in the body cavity that belonged to the same or a very closely related species. These forms are, however, generally distributed in this country. Leidy (1855) was the first to report them from the Atlantic coastal region.

Round- or threadworms are the most common parasites of fishes, and in number of species they exceed other internal parasitic worms. One finds them both free in the alimentary canal and encysted in the various organs of the body. They are mostly small and very uniform in appearance. In spite of their universal presence in fish it appears probable that they are rarely if ever of any marked disadvantage to their hosts. The small encysted forms which appear as knots or coils from one to several millimeters in diameter in the viscera, the lining of the body cavity, or more rarely in the muscles of the fish, are immature stages that are awaiting transfer to some other host to complete their development. The cysts are most abundant in small pan fish though not entirely wanting in the largest predatory fish.

These encysted worms have been reported often from market fish, as by Leidy (1878) in the shad. While they detract from the appearance of the flesh and interfere with ready sale, they are not harmful to the fish and do not injure its food value.

The larger predatory fish contain more frequently the adult stages of these worms as parasites free in the body cavity or the intestine. Only rarely are the parasites abundant enough to exercise any detrimental influence on the activity or health of the fish. When smaller fish become heavily infected, however, the draft on their energy may be sufficient to produce serious consequences. I have observed a heavy mortality among small fish, especially the stickleback, which was clearly due to parasitism by a nematode, from one to several specimens of which were found coiled up in the body cavity. The total mass of the parasites equalled or approached that of the fish. In large fish the number of such parasites which may be present without exercising any apparent effect on the welfare of the host is often astonishing.

The Acanthocephala are roundworms that possess a proboscis covered with hooks which they drive into the wall of the intestine and thus maintain their hold. They are present at times in very large numbers so that they almost occlude the lumen of the canal and the wall is badly distorted by the numerous proboscides driven into it. At times they bore their way through the wall into the body cavity. Perhaps by virtue of their ability to make wounds in the tissue they give rise to troubles of a serious type. At all events extensive fatal epidemics among fish, both in fish ponds and in nature, have been traced to their presence. I do not find that in this country any such direct association has yet been determined, but I have seen many instances in which they had caused serious injuries and the tables show that they are subject to most striking variations in number in individual cases.

One finds leeches often on the skin of fishes and in some cases the number is sufficient to be injurious to the fish. Lake trout and whitefish are not infrequently taken with large numbers of these worms on the surface of the body.

The crustacea are as characteristic external parasites as are the worms internal parasites. Numerous types of this great group are familiar to the fish culturist. The flattened scale-like fish lice, or Argulidæ, occur on fresh-water fish. In France at least they have been shown to be the cause of great damage to fish in artificial ponds, where they increase more easily than in nature. Thus far no effective means of disposing of them have been discovered. The numbers of such forms may be reduced to the minimum by keeping surface-feeding fish in the fish ponds, since the young forms of the parasites are free-living surface swimmers and are eagerly sought out and devoured by plankton-feeding fish.

The parasitic Copepoda, or Siphonostoma, are sometimes found on the skin but more frequently attached to the gill bars or gill covers inside the gill chamber. They present in the full grown condition an irregular, shapeless appearance that renders it difficult to recognize their close relationship to the group of free-living Copepoda which forms so important an element in the food of fishes. They are not so numerous in fresh-water fish as in the marine species and when the number of these ectoparasites found on a single host is not large, they are probably of little influence on it. Any considerable increase in numbers is accompanied by the death of the infected fish.

The external crustaceous parasites of fish can all be easily and readily determined by reference to the splendid series of recent studies on this group by C. B. Wilson. As the older accounts are important on account of their data concerning effects on fish they also are given in the list of papers although they contain imperfect and sometimes erroneous statements concerning the parasite and in all cases reference should also be made to the later papers by Wilson. Especial mention should be made of two papers (Wilson, 1902 and 1911b), which contain very complete synopses of the fish lice and the most frequent gill parasites and hence are of special value to the fish culturist seeking knowledge concerning forms of these types. Reference to the original papers is necessary if it is desired to determine accurately the species present. Even in such thoroughly studied groups it is too much to expect that the record is complete or that no other species than those listed are to be found on our fresh-water fish. The young of these species are free-swimming and seek out new hosts by active migration through the water. It is clear then, that small active plankton-feeding fish will tend to keep down the number of these parasites by destroying the young during this active stage.

SCIENTIFIC NAME	COMMON NAME	TOTAL INFECTION					TREMATODE INFECTION			CESTODE INFECTION			NEMATODE INFECTION			ACANTHOCEPHALA INFECTION		
		No. fish infected.	No. fish free from parasites.	Total no. fish examined.	Total no. parasites in all fish examined.	Average no. parasites per fish.	No. fish free from parasites.	No. parasites in all fish examined.	Average no. parasites per fish.	No. fish free from parasites.	No. parasites in all fish examined.	Average no. parasites per fish.	No. fish free from parasites.	No. parasites in all fish examined.	Average no. parasites per fish.	No. fish free from parasites.	No. parasites in all fish examined.	Average no. parasites per fish.
Acipenseridæ—																		
Acipenser rubicundus LeSueur	Lake sturgeon	2	....	2	85	43	...	75	38	2	....	....	....	10	5	2	....	....
Lepisosteidæ—																		
Lepisosteus osseus (Linnæus)	Long-nosed gar	3	1	4	5	2	3	1	1	2	4	2	4	....	....	4	....	....
Lepisosteus platostomus Rafinesque	Short-nosed gar	9	....	9	336	37	4	148	30	....	127	15	6	59	20	8	2	2
Amiidæ—																		
Amia calva Linnæus	Dogfish, bowfin	27	5	32	1,236	157	16	3,789	236	11	315	15	14	114	6	24	18	2
Siluridæ—																		
Ictalurus punctatus (Rafinesque)	Channel cat	6	....	6	60	10	3	33	11	2	22	6	5	4	4	5	1	1
Ameiurus natalis (LeSueur)	Yellow cat	1	....	1	19	19	....	17	17	....	1	1	1	....	....	....	1	1
Ameiurus nebulosus (LeSueur)	Horned pout	14	1	15	126	9	8	70	10	11	13	3	5	35	3	11	8	2
Ameiurus melas (Rafinesque)	Black bullhead	1	....	1	120	120	....	120	120	1	....	....	1	....	....	1	....	....
Schilbeodes miurus (Jordan)		....	3	3	....	....	1	....	....	1	....	....	1	....	....	1	....	....
Catostomidæ—																		
Ictiobus bubalus (Rafinesque)	Small-mouthed buffalo	17	....	17	569	33	12	16	3	1	539	34	16	1	1	12	13	3
Carpiodes carpio (Rafinesque)	Carp sucker	13	2	15	260	20	9	54	9	3	195	16	14	4	4	11	7	2
Carpiodes velifer (Rafinesque)	Quillback	1	....	1	1	1	1	....	....	...	1	1	1	....	....	1	....	....
Catostomus commersonii (Lacépède)	Sucker	6	....	6	474	79	5	5	5	2	80	20	6	....	....	2	389	97
Erimyzon sucetta oblongus (Mitchill)	Chub sucker	....	4	4	....	....	4	....	....	4	....	....	4	....	....	4	....	....
Moxostoma aureolum (LeSueur)	Red horse	19	4	23	624	33	20	39	13	19	6	2	17	9	2	4	570	30
Cyprinidæ—																		
Cyprinus carpio Linnæus	German carp	3	7	10	6	2	10	....	....	10	....	....	10	....	....	7	6	2
Campostoma anomalum (Rafinesque)	Stone roller	....	3	3	....	....	3	....	....	3	....	....	3	....	....	3	....	....
Pimephales notatus (Rafinesque)	Blunt-nosed minnow	....	5	5	....	....	5	....	....	5	....	....	5	....	....	5	....	....
Semotilus corporalis (Mitchill)	Silver chub	5	....	5	179	36	....	20	4	5	....	....	2	158	53	4	1	1
Notropis blennius (Girard)	Straw-colored minnow	5	23	28	9	2	28	....	....	23	9	2	28	....	....	28	....	....
Notropis shumardi (Girard)		....	10	10	....	....	10	....	....	10	....	....	10	....	....	10	....	....
Ericymba buccata Cope		....	5	5	....	....	5	....	....	5	....	....	5	....	....	5	....	....
Phenacobius mirabilis (Girard)		....	5	5	....	....	5	....	....	5	....	....	5	....	....	5	....	....
Anguillidæ—																		
Anguilla chrisypa Rafinesque	American eel	9	2	11	251	28	3	217	27	6	26	5	7	10	3	10	1	1

Hiodon tergisus LeSueur	Moon eye	7	6	13	644	92	7	475	79	10	22	7	7	145	24	12	2	2
rosomidæ—																		
Dorosoma cepedianum (LeSueur)	Gizzard shad	2	2	4	2	1	4	....	....	3	1	1	4	....	....	3	1	1
lmonidæ—																		
Coregonus quadrilateralis Richardson	Menominee whitefish	1	....	1	1	1	....	1	1	1	....	....	1	....	....	1	....	....
Coregonus clupeiformis (Mitchill)	Whitefish	17	....	17	1,174	69	17	....	....	16	2	2	17	....	....	....	1,172	69
Argyrosomus artedi (LeSueur)	Lake herring	1	....	1	53	53	1	....	....	....	13	13	....	20	20	....	20	20
Argyrosomus prognathus (H. M. Smith)	Longjaw	3	....	3	33	11	3	....	....	1	26	13	3	....	....	2	7	7
Argyrosomus nigripinnis Gill	Bluefin	1	....	1	307	307	1	....	....	....	303	303	1	....	....	....	4	4
Oncorhynchus gorbuscha (Walbaum)	Humpback salmon	75	....	75	8,545	114	10	2,972	46	5	5,101	73	21	439	7	67	33	4
Oncorhynchus keta (Walbaum)	Dog salmon	32	....	32	3,310	103	2	2,429	81	2	820	28	21	30	3	29	22	7
Oncorhynchus tschawytscha (Walbaum)	King salmon	35	7	42	2,155	70	32	858	86	13	1,225	42	22	307	18	38	5	1
Oncorhynchus kisutch (Walbaum)	Coho salmon	56	2	58	4,158	74	12	3,054	66	16	695	17	19	404	10	57	5	5
Oncorhynchus nerka (Walbaum)	Redfish	247	2	249	8,524	35	111	3,510	26	57	2,375	13	20	2,570	11	233	69	4
Salmo mykiss clarkii (Richardson)	Cut-throat trout	13	5	18	528	41	15	19	6	8	474	47	15	7	2	7	28	3
Salmo gairdneri Richardson	Steelhead	10	....	10	225	22	9	142	142	2	43	5	....	49	4	10	....	....
Salmo irideus Gibbons	Rainbow trout	2	....	2	30	15	....	28	14	2	....	....	1	2	2	2	....	....
Cristivomer namaycush (Walbaum)	Great Lakes trout	10	....	10	1,035	103	10	....	....	3	418	64	5	349	70	6	238	60
Salvelinus malma (Walbaum)	Dolly Varden trout	20	2	22	1,171	59	4	1,054	59	10	59	5	13	41	5	16	17	3
gentinidæ—																		
Osmerus mordax (Mitchill)	American smelt	50	8	58	270	5	10	169	4	17	101	2	58	....	....	58	....	....
cidæ—																		
Esox reticulatus LeSueur	Eastern pickerel	12	....	12	104	9	2	65	6	2	39	4	12	....	....	12	....	....
Esox lucius Linnæus	Pickerel	3	....	3	24	8	2	8	8	1	8	4	3	....	....	....	8	3
Esox masquinongy Mitchill	Muskallunge	1	....	1	15	15	....	15	15	1	....	....	1	....	....	1	....	....
sterosteidæ—																		
Gasterosteus williamsoni Girard	Alaska stickleback	37	19	56	94	3	56	....	....	43	16	1	27	75	3	54	5	2
ntrarchidæ—																		
Pomoxis sparoides (Lacépède)	Calico bass	10	2	12	88	9	10	51	26	11	3	3	6	15	3	5	10	3
Ambloplites rupestris (Rafinesque)	Rock bass	31	....	31	481	16	27	75	19	20	13	1	16	28	2	2	365	13
Lepomis pallidus (Mitchill)	Bluegill	6	1	7	328	55	4	190	63	7	....	....	1	110	18	1	28	5
Eupomotis gibbosus (Linnæus)	Sunfish	8	7	15	30	4	11	9	2	13	2	1	8	7	1	11	12	3
Micropterus dolomieu Lacépède	Small-mouthed black bass	44	1	45	3,818	87	24	951	45	27	116	8	38	18	3	14	2,703	87
Micropterus salmoides (Lacépède)	Large-mouthed black bass	2	....	2	149	75	1	123	123	....	3	2	2	....	....	....	23	12
rcidæ—																		
Stizostedion vitreum (Mitchill)	Wall-eyed pike	18	....	18	478	27	12	6	1	10	139	17	18	....	....	7	333	39
Stizostedion canadense (Smith)	Sauger	7	....	7	316	45	6	1	1	1	313	55	7	....	....	6	2	2
Perca flavescens (Mitchill)	Yellow perch	39	1	40	202	5	35	11	2	9	48	1	21	136	7	34	7	1
Hadropterus aspro (Cope & Jordan)	Black-sided darter	....	2	2	....	....	2	....	....	2	....	....	2	....	....	2	....	....
Diplesion blennioides (Rafinesque)	Green-sided darter	....	3	3	....	....	3	....	....	3	....	....	3	....	....	3	....	....
Etheostoma cæruleum Storer	Blue darter	....	4	4	....	....	4	....	....	4	....	....	4	....	....	4	....	....
rranidæ—																		
Roccus chrysops (Rafinesque)	White bass	12	1	13	298	25	1	295	25	11	2	1	12	1	1	13	....	....
ænidæ—																		
Aplodinotus grunniens Rafinesque	Fresh-water drum	14	....	14	145	10	....	131	9	13	4	1	12	10	5	14	....	....
ttidæ—																		
Cottus ictalops (Rafinesque)	Miller's thumb	21	24	45	183	9	44	20	20	30	130	9	41	33	8	45	....	....
didæ—																		
Lota maculosa (LeSueur)	Lawyer	3	....	3	247	82	1	11	6	....	56	19	3	....	....	1	180	90

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Records, among thirteen diseases affecting salmon and trout, heavy mortality among young lake trout due to *Gyrodactylus elegans*. Remedy by bath of one part cider vinegar with three parts water.

BEAN, TARLETON H.

1891. Report on the salmon and salmon rivers of Alaska, with notes on the conditions, methods and needs of the salmon fisheries. Bulletin U. S. Fish Commission, vol. IX, 1889, p. 165-208.

Notes numerous intestinal worms in red salmon; parasitic copepods on all species of salmon. A disease among rainbow trout which has caused great mortality is probably due to encysted parasites, chiefly in the kidneys, but also in liver and spleen. Dolly Varden trout taken at Karluk Lake, nearly dead, had the mouth full of large lernæan parasites.

1894. Life history of the salmon. Ibid., vol. XII, 1892. p. 21-38.

Data on parasites same as in Bean, 1891.

1907a. Some practical difficulties in the way of fish culture. Transactions American Fisheries Society, 36th meeting, p. 184-192.

Notes eye disease of young trout as a new bacterial disease, not to be confused with pop-eye, a parasitic disease. Also the gill louse so fatal to trout 2 or 3 years' old.

1907b. Report of State Fish Culturist for the year 1906. Twelfth Annual Report New York Forest, Fish and Game Commission, p. 129-130, 131-142. (In report for 1904-5-6, p. 177-231.)

At the Adirondack hatchery a gill parasite is very injurious to trout, especially those of one and two years, and older. The only check is the introduction of a surface feeding fish to consume the swimming larvæ of the parasite. The waters of Spring Creek are so badly infected that it is no longer possible to rear brook trout in ponds fed by this stream. The parasite was identified as *Lernæopoda salmonea*. It does not attack brown trout or rainbow trout. In black bass larval cestodes are sometimes abundant, but are not known to influence the fish unfavorably.

The extensive section on fish diseases is a translation in part of Hofer, 1904 (q. v.).

1908. Report of the State Fish Culturist. Ibid., 13th report, p. 1-63.

Parasite (*Filaria rubra* Leidy) found in intestine of catfish in Hackensack River. Also occurs in eels and sunfish in that region.

1910a. Notes on New York fishes. Ibid., 14th report, p. 192-228.

Notes a larval worm (nematode?) in eruptions on the skin of the eel, others in the skin of black bass (determined as nematode by Dr. Linton). Encysted distomes in the skin of yellow perch were also determined by Linton provisionally as distomes in larval stages. The adult *Diplostomum* occurs in fish-eating birds.

1910b. A plea for the systematic study of fish diseases. Transactions American Fisheries Society, 39th meeting, p. 65-73.

Emphasizes the importance of the subject, and scanty knowledge to date. Gives bibliography with reviews of most important papers.

1911. Notes on black bass. Ibid., 40th meeting, p. 123-128.

Notes on the occurrence of various parasites in food fishes in New York hatcheries and aquaria. Records the occurrence of both nematodes and trematodes in the eyes in cases examined.

Benedict, H. M.

1900. On the structure of two fish tapeworms from the genus Proteocephalus, Weinland 1858. Journal of Morphology, vol. xvi, p. 337-368, 1 pl.

Detailed study of *Proteocephalus ambloplitis* (Leidy) from black bass and *P. ocellatus* (Rud) from whitefish. The material was taken from a collection made at Lake St. Clair (cf. Ward, 1894c). The species studied were recently determined by La Rue (1911) as *Proteocephalus exiguus* n. sp. and *P. ambloplitis* (Leidy).

Calkins, G. N.

1899. Report upon the recent epidemic among brook trout. Fourth Report New York Forest, Fish and Game Commission, p. 175-190.

The epidemic, equally fatal to fish of all ages, is characterized by deep ulcers. It is caused by a sporozoan parasite, *Lymphosporidium truttae*, which is fully described in its various stages. Every fish at this trout farm succumbed to this disease.

1900a. Lymphosporidium truttae, nov. gen. nov. spec., the cause of a recent brook trout epidemic. Science, n. s., vol. xii, no. 306, p. 64-65.

Summary of report on epidemic, giving also main facts in structure and life history of causal organism.

1900b. Lymphosporidium truttae, nov. gen. nov. sp., the cause of a recent epidemic among brook trout, Salvelinus fontinalis. Zoologischer Anzeiger, bd. xxiii, p. 513-520, 6 fig.

Extended account of the parasite and of the epidemic. The stages in the life history of the organism are described carefully and the possible relationship to other groups of Sporozoa discussed. Since the organism was not discovered until the fish had perished, both the origin of the disease and the remedy remain undetermined.

1900c. Lymphosporidium truttae, nov. gen. nov. sp., the cause of a recent epidemic among brook trout. Proceedings American Association for the Advancement of Science, 49th meeting, p. 238-239.

Brief extract.

Conner, Charles H.

1905. Glochidia of Unio on fishes. Nautilus, vol. xviii, p. 142-143.

On anal and caudal fins of sunfish.

Dana, J. D., and Herrick, E. C.

1837. Description of the Argulus Catastomi, a new parasitic crustaceous animal (with figures). American Journal of Science, vol. xxxi, p. 297-308.

Found on operculum within the branchial chamber of the sucker in Mill River.

Dunning, Philo, and others.

1884. Two hundred tons of dead fish, mostly perch, at Lake Mendota, Wisconsin. Bulletin U. S. Fish Commission, vol. iv, 1884, p. 439-443.

Theory that the epidemic was due to a parasite (leech?) eaten by the perch. Another view that the cause is a parasite feeding upon the gills. [Neither of these views was substantiated by later investigations; see Forbes, 1890.]

Eggeling, O., and Ehrenberg, Fr.

1908. The fresh-water aquarium and its inhabitants. 352 p., illus. New York.

Discusses briefly many forms of animal parasites found on fishes. Notes their rapid increase and hence more serious character in the narrow limits of the aquarium.

FELLOWS, C. S.

1888. A description of Ergasilus chautauquaensis, a new species of Copepoda, and a list of other Entomostraca found at Lake Chautauqua in August, 1886. Proceedings American Society of Microscopists, vol. IX, p. 246-249.

First note on this common parasitic species of which the host is even yet unknown.

FORBES, S. A.

1890. Preliminary report upon the invertebrate animals inhabiting Lakes Geneva and Mendota, Wisconsin, with an account of the fish epidemic in Lake Mendota in 1884. Bulletin U. S. Fish Commission, vol. VIII, 1888, p. 473-487.

Disproves parasitic theory of epidemic.

1894. The aquarium of the United States Fish Commission at the World's Columbian Exposition. Ibid., vol. XIII, 1893, p. 143-158.

Young catfish (*Ameiurus albidus*) from the Potomac River were attacked by a skin disease. The skin was covered with minute white specks; the fish ceased to feed and began to die; due to *Ichthyophthirius*, recorded as an aquarium parasite especially destructive to young trout in Europe. Further study of the disease assigned to Dr. C. W. Stiles (cf. Stiles, 1894).

GAGE, S. H.

1893. The lake and brook lampreys of New York, especially those of Cayuga and Seneca Lakes. Wilder Quarter-Century Book, p. 421-492, 8 pl.

The lake lamprey is wholly parasitic during its adult life. From the economic standpoint the destruction of lampreys is desirable and can be accomplished when they congregate to ascend the tributaries for spawning.

1898. Transformation of the brook lamprey (Lampetra wilderi) and parasitism among lampreys. Proceedings American Association for the Advancement of Science, 47th meeting, p. 372-373.

While the lake lamprey is exclusively parasitic, the brook lamprey has no parasitic life.

GOLDBERGER, JOSEPH.

1911. Some known and three new endoparasitic trematodes from American fresh-water fish. Bulletin Hygienic Laboratory, U. S. Public Health and Marine-Hospital Service, no. 71, 35 p., 5 pl.

Discusses *Leuceruthrus micropteri* from black bass and bowfin, *Azygia loossii* (cf. Marshall & Gilbert, 1905b), *A. acuminata* from bowfin, *A. bulbosa* from the same host, and also *Hassallius hassalli* from rock bass.

GRAYBILL, H. W.

1902. Some points in the structure of the Acanthocephala. Transactions American Microscopical Society, vol. XXIII, p. 191-200.

The parasites were collected from the rock bass and the black bass in the Great Lakes.

GURLEY, R. R.

1893. On the classification of the Myxosporidia, a group of protozoan parasites infesting fishes. Bulletin U. S. Fish Commission, vol. XI, 1891, p. 407-420.

Preliminary report dealing especially with the classification of these parasites.

GURLEY, R. R.—Continued.

1894. The Myxosporidia, or psorosperms of fishes, and the epidemics produced by them. Report U. S. Fish Commission, 1892, p. 65-304, 47 pl.

Monographic account of these parasites. Effects, epidemics, structure, classification and records of occurrence. From fresh water in North America 6 species are recorded, viz: *Myxobolus monurus* in pirate perch; *M. transovalis* in shiner; *M. oblongus* and *M. globosus* in sucker; *M. macrurus* in a minnow; *M. linearis* in the bullhead, and an unidentified species in a minnow. This list is exceedingly incomplete as these forms have not been studied extensively.

HOFER, B.

1904. Handbuch der Fischkrankheiten, 384 p., 18 pl. color. Munich.

Abstracted in Bean, 1910. Translations of some sections are given by Bean, 1907.

KELLICOTT, D. S.

1877. Description of a new species of Argulus. Bulletin Buffalo Society of Natural Sciences, vol. III, p. 214-216, 1 pl.

From the gar pike taken in the Niagara River near Buffalo; named *Argulus lepidostei*. Fastened near pectoral fins or in gill cavity.

1880. Argulus stizostethii, n. sp. American Journal of Microscopy and Popular Science, vol. v, p. 53.

Description with figures of species from blue pike; the larva of this parasite has been described elsewhere by the same author (cf. Wilson, 1902, p. 640, 713).

1886. A note on Argulus catastomi. Proceedings American Society Microscopists, vol. VIII, p. 144.

Reports this species of fish louse from suckers in Cayuga Lake.

KERBERT, C.

1886. Chromatophagus parasiticus—a contribution to the natural history of parasites. Report U. S. Fish Commission, 1884, p. 1127-1136. Translated from the German.

Full description of dangerous skin parasite producing epidemics in fresh-water fishes held in aquaria. Same species later studied in this country by Stiles, 1894 (q. v.).

LA RUE, G. R.

1911. A revision of the cestode family Proteocephalidæ. Zoologischer Anzeiger, bd. XXXVIII, p. 473-482.

Preliminary report on the most abundant type of fish tapeworms with descriptions of each species, including three new genera and nine new species. Many old forms are accurately described for the first time.

LEFEVRE, G., and CURTIS, W. C.

1910. Reproduction and parasitism in the Unionidæ. Journal of Experimental Zoology, vol. IX, p. 79-115, 5 pl.

Infections observed in nature during November. Roach, carp, perch, bluegill, rock bass and crappie. Only 1 to 20 glochidia on each fish. Artificial infection far greater in extent. Under natural conditions maximum infections never obtain.

LEIDY, JOSEPH.

1851. Contributions to helminthology. Proceedings Academy Natural Sciences, Philadelphia, vol. v, p. 205-210.

Records *Distomum longum* and *D. tereticolle* from pike; *Echinorhynchus lateralis* from brook trout; *E. proteus* from white bass.

1853. On nodular bodies embedded in the tail and fins of fishes, a parasitic worm of the genus Distoma. Ibid., vol. VI, p. 433.

Brief record of specimen.

LEIDY, JOSEPH—Continued.

1855. Notices on some tapeworms. Ibid., vol. VII, p. 43.

Records *Ligula monogramma* from chub.

1856. A synopsis of Entozoa and some of their ectocongeners, observed by the author. Ibid., vol. VIII, p. 42-58.

Records *Clinostomum gracile* from pike and larva encysted in sunfish which latter harbors also *Diplostomum; Filaria rubra* from white bass; *F. quadrituberculata* from the eel.

1871. Notice of some worms, Dibothrium cordiceps, Hirudo, Gordius. Ibid., vol. XXIII, p. 305-307.

Describes specimens of trout from Yellowstone River infested with tapeworm *Dibothrium cordiceps.* Species studied later by Linton, 1891a.

1875. On psorosperms in a mallard duck. Ibid., vol. XXVII, p. 126-127.

Infection may have come from infected fish.

1878. On parasitic worms in the shad (Filaria capsularia). Ibid., vol. XXX, p. 171.

Description of cysts of *Agamonema capsularia* from shad and herring; often very numerous. Does not affect fish or render it unwholesome as food

1882. Filaria of the black bass. Ibid., vol. XXXIV, p. 69.

Encysted red worms sometimes very common. Described but not determined.

1885. Bothriocephalus in trout. Ibid., vol. XXXVII, p. 122-123.

Record of specimens taken from trout. Brief description of form named *B. cestus.*

1886a. On Amia and its probable Tænia. Ibid., vol. XXXVIII, p. 62.

Note on the occurrence in the bowfin of a species probably *T. filicollis.*

1886b. Notices of nematoid worms. Ibid., vol. XXXVIII, p. 308-313.

Includes description of *Filaria stigmatura* from lake trout.

1887. Notice of some parasitic worms. Ibid., vol. XXXIX, p. 20-24.

Includes description of *Tænia amblophitis* from rock bass; *T. micropteri* from black bass; *Distomum hispidum* from sturgeon.

1888a. Parasites of the pickerel. Ibid., vol. XL, p. 169.

Describes *T. leptosoma* from pike; may be identical with *T. amblopitis* from rock bass.

1888b. Parasites of the striped bass. Ibid., vol. XL, p. 124-125.

Records *Ergasilus labracis* from gills of striped bass and *Echinorhynchus proteus* from intestine. Migratory fish.

1888c. Parasites of the rock fish. Ibid., vol. XL, p. 166-168.

In addition to these noted above describes *Distomum galactosomum,* a new species, and *Agamonema capsularia.*

1888d. Parasites of the shad and herring. Journal of Comparative Medicine and Surgery, vol. IX, p. 211-217.

Migratory fish. Shad from Delaware River harbored *Agamonema capsularia, Ascaris adunca,* and *Gymnoscolex picta.* Herring harbor the first and third only.

1890. Notices of Entozoa. Ibid., 1890, p. 410-418.

Describes *Echinorhynchus paucihamatus* from black bass; *Tænia nematosoma* from pike.

LINTON, E.

1891a. On two species of larval Dibothria from the Yellowstone National Park. Bulletin U. S. Fish Commission, vol. IX, 1889, p. 65-79, pl. XXIII-XXVII.

Describes *Ligula catostomi* from the body cavity of the sucker and records fragments of the same from the stomach of the trout. Also from the abdominal muscles of the trout, *Dibothrium cordiceps*.

1891b. Contribution to the life history of Dibothrium cordiceps, a parasite infesting the trout of Yellowstone Lake. Ibid., vol. IX, 1889, p. 337-358, pl. CXVII-CXIX.

Describes more fully this species, noted in earlier paper (1891a), giving data on distribution, frequence, and effects on the host. Adult stage found in the white pelican and discussed in detail together with the general problem of parasitism in trout of Yellowstone Lake, the cause, and the remedy.

1891c. Notice of the occurrence of protozoan parasites (psorosperms) on cyprinoid fishes in Ohio. Ibid., vol. IX, 1889, p. 359-361.

Description of an undetermined species on several small minnows.

1893. On fish Entozoa from Yellowstone National Park. Report U. S. Fish Commission, 1899-91, p. 545-564, pl. 63-67.

In addition to forms previously described (1891a) *Monobothrium terebrans* from the sucker, and encysted distoma from the chub; *Distomum laureatum* from the trout; *Echinorhynchus globosus* from trout; *E. tuberosus* from sucker and chub; *Dachnitis globosa* from trout and three unidentified nematodes from the same host.

1894. Some observations concerning fish parasites. Bulletin U. S. Fish Commission, vol. XIII, p. 101-112.

Discussion of frequence of parasites, distinctness of host relationships, injurious effects of Entozoa, the remedies for parasitic diseases and the important problems which present themselves to the helminthologist. Many details given concerning parasites of fresh-water fishes.

1897. Notes on cestode parasites of fishes. Proceedings U. S. National Museum, vol. XX, p. 423-456, 8 pl.

Records *Tænia salvelini* from lake trout; *T. dilatata* from eel; *T. ocellata* from rock bass; *T. monobothrium hexacotyle* from sucker; *Schistocephalus dimophus* from blob; *Cyathocephalus truncatus* from whitefish, *Dibothrium hastatum* from paddlefish; *Dibothrium infundibuliforme* from lawyer and lake trout; *Dibothrium ligula* from sucker, smelt, silver minnow, redfin; and other species not from fresh-water fish.

1898a. An economical consideration of fish parasites. Bulletin U. S. Fish Commission, vol. XVII, 1897, p. 194-199.

General discussion of relations of parasites to fish culture. Considers also effect of each type of parasite, their frequence and economic importance.

1898b. Notes on trematode parasites of fishes. Proceedings U. S. National Museum, vol. XX, p. 507-548, 15 pl.

Records from fresh-water fish: *Diplostomum cuticola* from various sunfish; *Distomum auriculatum* from the lake sturgeon; *D. gracile* from the bluegill; besides others from migratory and marine fishes as well as some unidentified species.

1901a. Fish parasites collected at Woods Hole in 1898. Bulletin U. S. Fish Commission, vol. XIX, 1899, p. 267-304, pl. 33-43.

Parasites of salt-water fish save only one migrant, eel, which was only very poorly infested.

LINTON, E.—Cont.

1901b. Parasites of fishes of the Woods Hole region. Ibid., vol. XIX, 1899, p. 405-492, pl. I-XXXIV.

Among numerous records of marine fishes are included the following from migratory or strictly fresh-water hosts: *Dacnitis sphærocephala. Nitzschia elegans* from the sturgeon; *Echinorhynchus attenuatus* from the short-nosed sturgeon; *E. globosus, E. agilis* from the eel; *Tænia dilatata, Rhynchobothrium heterospine, R. imparispine, R. bulbifer, Distomum grandiporum, D. vitellosum, Ascaris* sp. from salmon; *Cucullanus elegans* from brook trout.

MACCALLUM, W. G.

1895. On the anatomy of two distome parasites of fresh-water fish. Veterinary Magazine, vol. II, no. 7, 12 p., 8 fig.

Describes *Distomum isoporum*, var. *armatum* from fresh-water drum, bluegill and sturgeon; also *D. lobotes* from eel, perch and wall-eye. Records further *D. nodulosum* from rock bass, eel, sunfish, drum, sturgeon, black bass; and *D. opacum* from eel. All of the parasites noted are flukes.

MARSH, M. C.

1906. The Cold Spring Harbor epidemic among trout. Tenth Annual Report N. Y. Forest, Fish and Game Commission, p. 125-139. (In Report for 1904-5-6, p. 149-161.)

Describes epidemic of 1904 which destroyed most of the adult stock at the station. Regarded as due to *Lymphosporidium truttæ* (cf. Calkins, 1900). Advises to avoid overcrowding, to transfer to larger quarters with better flow of water, and to use chloride of lime or sulphate of copper as disinfectant.

MARSHALL, WILLIAM, and GILBERT, N. C.

1905*a*. Notes on the food and parasites of some fresh-water fishes from the lakes at Madison, Wis. Report U. S. Bureau of Fisheries, 1904, p. 513-522.

In the gar were found a few trematodes and cestodes yet unnamed. In the bowfin parasites were very prevalent. The bullhead sheltered prominently cestodes. Parasites were regularly present in the fish examined. The white bass and calico bass had few parasites, and the rock bass sheltered many Acanthocephala. In the large-mouth black bass no individual was free from parasites. Cestodes and Acanthocephala most abundant. Perch are also heavily infected even in winter.

1905*b*. Three new trematodes found principally in black bass. Zoologische Jahrbücher, Abt. Syst., bd. XXII, p. 475-488, 1 taf.

Common in fish from lakes around Madison (Wis.). The species were named *Cæcincola parvulus, Leucerutlirus micropteri* and *Azygia loossii*. The pike and bowfin were also infected with last-named species.

MILNER, J. W.

1874. Report on the fisheries of the Great Lakes, the result of inquiries prosecuted in 1871 and 1872. Report U. S. Commission of Fish and Fisheries, 1872-1873, p. 1-75.

Found in lake trout a few parasites, especially a tapeworm that is very numerous in same. The cisco also carries tapeworms in abundance and a lernæan on the skin. This is parasitic on the whitefish, as are also a leech, *Ichthyobdella punctata* (Smith), and two intestinal parasites, a cestode (?) and an *Echinorhynchus*. The most marked parasite of the lake herring is a larval cestode in the dorsal muscles, common in April but not later than June. It has also intestinal parasites.

NICKERSON, W. S.

1900. Concerning Cotylogaster occidentalis. Science, n. s., vol. II, p. 250.

Brief abstract of following paper.

NICKERSON, W. S.—Continued.

1902. Cotylogaster occidentalis n. sp. and a revision of the family Aspidobothridæ. Zoologische Jahrbücher, Abt. Syst., bd. XV, p. 597-624, 2 taf.

Detailed description of parasite found in sheepshead in Minnesota. Systematic outline of this family of flukes.

OSBORN, H. L.

1902. Notes on the trematodes of Lake Chautauqua, N. Y. Science, n. s., vol. XV, p. 573-574.

Records *Microphallus opacus* (Ward) as frequent in black bass, and its larva in crayfishes. *Bunodera* (sp.) occurs also in the black bass. Two other undetermined flukes are found in rock bass, darters and sunfish (cf. following titles for data regarding these parasites).

1903a. Bunodera cornuta sp. nov., a new parasite from the crayfish and certain fishes of Lake Chautauqua, N. Y. Biological Bulletin, vol. v, p. 63-73, 7 fig.

This parasite occurs in black bass, rock bass and bullheads at Chautauqua Lake, and the young in crayfish there. The structure and life history are described in detail and comparisons made with European species that are closely allied parasites.

1903b. On Cryptogonimus chyli, n. g., n. sp., a trematode from Lake Chautauqua, N. Y., with novel type of ventral sucker. Science, n. s., vol. XVII, p. 533-534.

Brief description of the structure of a small fluke common in black bass.

1903c. On Cryptogonimus (n. g.) chili (n. sp.), a fluke with two ventral suckers. Zoologischer Anzeiger, bd. XXVI, p. 315-318, 2 fig.

Brief account of a new species of fluke found in black bass.

1910. On the structure of Cryptogonimus (nov. gen.) chyli (n. sp.), an aberrant distome from fishes of Michigan and New York. Journal of Experimental Zoology, vol. IX, p. 517-536.

Extended account of the structure and relationships of this parasite which occurs in stomach and intestines of black bass and rock bass. It is found in the St. Mary's River and in Chautauqua Lake, also in Canada (Stafford, 1905).

1911. On the distribution and mode of occurrence in the United States and Canada of Clinostomum marginatum, a trematode parasite in fish, frogs and birds. Biological Bulletin, vol. XX, p. 350-366.

Full discussion of encysted stages in black bass, perch, sunfish where it occurs in muscle tissue. Adult stage in fish-eating birds.

PRATT, H. S.

1900. Synopsis of North American invertebrates. XII.—The trematodes, part 1, The Heterocotylea or monogenetic forms. American Naturalist, vol. XXXIV, p. 645-662.

Systematic topography; figures of each species.

1902. Synopsis of North American invertebrates. XII.—Trematodes, part 2, The Aspidocotylea and the Malacotylea, or digenetic forms. Ibid., vol. XXXVI, p. 887-910, 953-971, 130 fig.

Systematic synopsis; key, description of all species, figures of most. Bibliography.

RATHBUN, RICHARD.

1885. Annotated list of the described species of parasitic Copepoda (Siphonostomata) from American waters contained in the National Museum. Proceedings U. S. National Museum, vol. VII, p. 483-492.

Few species on migratory fishes, Atlantic and Pacific salmon, eel, sturgeon; also one species, *Lernæopoda coregoni* (Smith) from the whitefish in Lake Superior.

RUTTER, CLOUDSLEY.

1903. Natural history of the quinnat salmon. A report of investigations in the Sacramento River 1896-1901. Bulletin U. S. Fish Commission, vol. XXII, 1902, p. 65-141.

Records gastric parasites in young salmon, 15 per cent being infected on the average. "It is evident that residence in fresh water is conducive to the growth of parasites in the stomachs of young salmon." In spawning salmon, intestinal parasites frequent. "Another common pest of the salmon in fresh water is a parasitic copepod which attaches itself to gill filaments. There are not usually very many on one fish, but sometimes the gills are almost destroyed by them." (See plates 13 and 15.)

RYDER, J. A.

1880. The psorosperms found in Aphredoderus sayanus. American Naturalist, vol. XIV, p. 211-212, 2 pl.

Encysted in subcutaneous intermuscular tissue of pirate perch from Woodbury, N. J. According to prevalent view regarded as young of *Gregarina*, now known to belong to *Myxosporidia*. This species named *Myxobolus monurus* by Gurley, 1893.

SEAL, WM. P.

1889. The aquarium; a brief exposition of its principles and management. Bulletin U. S. Fish Commission, vol. VII, 1887, p. 274-282.

Fish are sometimes infested with parasites, some of them microscopic and of serious effect. But little is known of fish diseases.

1892. Observations on the aquaria of the U. S. Fish Commission at Central Station, Washington, D. C. Bulletin U. S. Fish Commission, vol. X, 1890, p. 1-12, pl. 1-4.

Goldfish and carp frequently infected by minute infusorian not determined; catfish, sunfish, white perch, trout and others infested in winter by *Chromatophagus parasiticus* (*Ichthyophthirius*). All have yielded to brackish water treatment. Parasite most persistent and troublesome in fresh-water aquaria. Few fresh-water fish free from its ravages.

SMITH, EUGENE.

1902. The home aquarium, p. 182-183. New York.

Parasitic diseases offer a wide field for investigation. Remove diseased individuals. An aquarium once infected is difficult to clear of parasites.

SMITH, S. I.

1874. The Crustacea of the fresh waters of the United States Report U. S. Commission of Fish and Fisheries 1872-73, p. 638-665.

Synopsis of the parasitic Crustacea on United States fresh-water fishes. Lists *Argulus catostomi* on sucker, *Lepeophtheirus salmonis* on salmon, *Actheres pimelodi* on channel cat, *Lernatopoda fontinalis* on brook trout, apparently the cause of the death of these fish, *L. siscowet* on lake trout, *L. coregoni* on whitefish, *Cauloxenus stygius* on blind fish, *Lernæocera cruciata* on rock bass and *L. catostomi* on the large-scaled redhorse.

STAFFORD, J.

1902. Notes on worms. Zoologischer Anzeiger, bd. XXV, p. 481-483.

Records *Spathidium folium* (von Olfers) from common bullhead, *Bunodera nodulosa* (Zeder) from brook trout, *Creadium isoporum* (Looss) from chub; they "differ in some respects from the European forms." Other undetermined species noted.

1904. Trematodes from Canadian fishes. Ibid., bd. XXVII, p. 481-495.

Records several species from migratory fishes, localities not given; also *Diplobothrium armatum* (F. S. Leuckart) from lake sturgeon; *Megadistomum longum* (Leidy) from muskallunge; *Azigia tereticolle* (Rudolph) [error, see Ward, 1910] from pike, lawyer and great catfish; *Mimodistomum angusticaudum* from lawyer and wall-eye; *Bunodera nodulosa* (Zeder) from perch; *Crepidostomum laureatum* (Zeder) from brook trout; *Crepidostomum cornutum* Osborn from rock bass; *Acrodactyla petalosa* Lander from lake sturgeon; *Phyllodistomum folium* (von Olfers) from pike; *Phyllodistomum superbum* from common bullhead and perch; *Deropristis hispidus* (Abil.) from lake sturgeon; *Centrovarium lobotes* (MacCallum from pike and wall-eye; *Clinostomum gracile* Leidy from perch; *Allocreadium isoporum* Looss from chub; *Plagioporus serotinus* from large-scaled sucker; *Protenteron diphanum* from rock bass; *Diplostomum cuticola* (Dies.) from rock bass; *Diplostomum parvulum* from chub and pike; *Gasterostomum pusillum* from wall-eye; *Monostomum amiuri* from common bullhead.

1905. Trematodes from Canadian vertebrates. Ibid., bd. XXVIII, p. 681-694.

Records *Tetraonchus unguiculatus* Wag. from rock bass and common sunfish; *Cryptogonimus chyli* Osborn from rock bass.

STILES, C. W.

1894. Report on a parasitic protozoan observed on fish in the aquarium. Bulletin U. S. Fish Commission, vol. XIII, 1893, p. 173-190, pl. 11-12.

Extended study of epidemic reported by S. A. Forbes (1894). Careful description of parasite and of lesions produced by it. The form is *Ichthyophthirius multifiliis*. The most practical method of destroying the parasite is to attack it during the free stage period or subsequent to encystment or during the encysted stage, which lasts from one to four days. Salts in the bottom of the aquarium and a very weak solution of methylen blue and eosin gave good results. The reduction of the temperature of the water was followed by a cessation of the epidemic.

STILES, C. W., and HASSALL, A.

1894. A preliminary catalogue of the parasites contained in the collections of the U. S. Bureau of Animal Industry, U. S. Army Medical Museum, Biological Department of the University of Pennsylvania (Coll. Leidy and in Coll. Stiles and Coll. Hassall). Veterinary Magazine, vol. II, p. 245-354.

Lists among others parasites from fresh-water fishes.

1902-1911. Index-catalogue of medical and veterinary zoology. Bulletin Bureau Animal Industry, no. 39, U. S. Department of Agriculture. (Authors, parts 1-35.)

Extremely valuable and very complete list of all papers on animal parasites. Includes papers on fish parasites and on American fresh-water species among others. Author list just completed. Subject indices to follow.

SURFACE, H. A.

1898a. Removal of lampreys from the interior waters of New York. Fourth Annual Report New York Forest, Fish and Game Commission, p. 191-245.

The lamprey is one of the most serious enemies of fresh-water fish; it attacks thirty species or more, including the most valuable. The life-history of the lamprey is discussed in detail and measures are proposed for exterminating this species.

SURFACE, H. A.—Continued.

1898b. The lampreys of central New York. Bulletin U. S. Fish Commission, vol. XVII, p. 209-215, pl. 10-11.

Description of habits of lampreys and of loss to fish by their attacks. Method for their elimination from waters of New York State.

VERRILL, A. E.

1873. Report upon the invertebrate animals of Vineyard Sound and the adjacent waters, with an account of the physical characteristics of the region. Report U. S. Commission of Fish and Fisheries, 1871-72, p. 295-778.

Mentions the occurrence of parasites on both fresh- and salt-water fishes. Details given refer to salt-water species.

1874. Synopsis of the North American fresh-water leeches. Report U. S. Fish Commission 1872-1873, p. 666-689.

Outlines effects of leeches on fish. The large blood-sucking leeches attack fishes directly, even fishes of considerable size, and destroy them very quickly by sucking their blood; other species are true parasites of fishes and often, when numerous, do them much injury. Still others destroy the food of fishes. Lists the species then known.

WARD, H. B.

1894a. On the parasites of the lake fish. I.—Notes on the structure and life-history of Distoma opacum, n. sp. Proceedings American Microscopical Society, vol. XV, p. 173-182, 1 pl.

A species abundant in the bowfin, occurring also in the white catfish and the perch. The young form is found encysted in crayfish.

1894b. Some notes on the biological relations of the fish parasites of the Great Lakes. Proceedings Nebraska Academy of Sciences, vol. IV, p. 8-11.

Data identical with those in the following paper.

1894c. A preliminary report on the worms (mostly parasitic) collected in Lake St. Clair in the summer of 1893. Bulletin Michigan Fish Commission, no. IV, p. 49.

Record of parasites found in fish of twenty species. The smallmouth black bass was most seriously infected. The data obtained are included in the tables of the present paper.

1901a. Notes on the parasites of the lake fish. III.—On the structure of the copulatory organs in Microphallus nov. gen. Transactions American Microscopical Society, vol. XXII, p. 175-187, 1 pl.

Further description of parasite first reported in 1894, now included in new genus.

1901b. Cestoda. Wood's Reference Handbook of the Medical Science, rev. ed., vol. II, p. 779-794.

General account of group. Full data regarding human parasites. Limited data on fish parasites, especially *Dibothriocephalus latus* and other forms acquired by man from fish.

1903a. Nematoda. Ibid., vol. VI, p. 205-225, fig.

General. Full discussion of human parasites. Few references to parasites of fish, particularly those transmitted to man.

1903b. Trematoda. Ibid., vol. VII, p. 860-873, fig.

General. Complete only regarding human parasites. Casual references only to fish parasites.

1905. The relations of animals to disease. Science, n. s., vol. XXII, p. 193-203; also Transactions American Microscopical Society, vol. XXVII, p. 5-20.

Considers the different ways in which animals may spread and cause disease.

WARD, H. B.—Continued.

1907. The influence of parasitism on the host. Science, n. s., vol. xxv, p. 201-218; also in Proceedings American Association for the Advancement of Science, 56th meeting, p. 489-523.

Discussion of the precise influence of parasites on host; summarized in the introduction to this paper. Frequent references to fish. Discusses influence of lamprey, effect of broad fish tapeworm, and other fish parasites.

1908. Some points in the migration of Pacific salmon as shown by its parasites. Transactions American Fisheries Society, 37th meeting, p. 92-100.

Records species present and their probable origin, as well as the effect on them of the trip up fresh-water streams to the spawning grounds.

1909. The influence of hibernation and migration on animal parasites. Proceedings 7th International Zoological Congress, Boston, 12 p.

Compares conditions in marine, migratory and fresh-water fishes, as regards distribution, occurrence and abundance of parasites.

1910. Internal parasites of the Sebago salmon. Bulletin U. S. Bureau of Fisheries, vol. XXVIII, 1908, p. 1151-1194.

Records from Sebago salmon *Azygia sebago*, *Abothrium crassum*, *Protocecphalus pusillus*, bothriocephalid larvæ and unidentified nematodes. The total number of parasites found is very small; the species are characteristic of fresh water. The paper gives also records of parasites found in the European salmon and compares conditions with those in the Sebago form.

WASHBURN, F. L.

1886. Mortality of fish at Lake Mille Lac, Minn. American Naturalist, vol. xx, p. 896-897.

An annually recurring epidemic in summer which destroys thousands of fish is caused by an external parasite, one of the Siphonostomata; some fish show large eaten patches on the sides and belly. The walleye is most seriously affected, but perch, rock bass, black bass, calico bass, crappie, a whitefish, the ling, bowfin, pike and large suckers are also attacked.

WILSON, C. B.

1902. North American parasitic copepods, of the family Argulidæ, with a bibliography of the group and a systematic review of all known species. (Paper 1.) Proceedings U. S. National Museum, vol. xxv, p. 635-742, pl. 8-27.

Discusses habits of these ectoparasites. *Argulus catostomi* occurs on the sucker and chub sucker, and will attack sunfish, dace, perch and minnow. *A. versicolor* lives on pickerel, but was raised on redfins. Records epidemics due to these species and experiments in limiting the number of such parasites by introducing surface-feeding fish to prey on the free-swimming larvæ. Extended discussion of habits with key to species and descriptions of each. *Argulus lepidostei* from the gar, *A. stizostethii* from blue pike, *A. maculosus* from muskallunge, *A. americanus* from the bowfin, are North America fresh-water species.

1904. A new species of Argulus, with a more complete account of two species already described. (Paper 2.) Ibid., vol. XXVII, p. 627-655, 38 fig.

Detailed description of structure and development of *A. americanus* from the bowfin, *A. versicolor* from pickerel, and *A. trilineata* from goldfish.

WILSON, C. B.—Continued.

1905. The fish parasites of the genus Argulus found in the Woods Hole region. Bulletin Bureau Fisheries, vol. XXIV, 1904, p. 115-131, 31 fig.

Refers to fishes, mostly marine, of Woods Hole region. Adds to general data in previous paper description of eggs and larvæ of fish lice. As an economic factor argulids are unimportant ordinarily. When fish becomes weak by change from salt to fresh water, by disease, lack of food or rise in temperature, serious results may follow. Discusses epidemics noted in Washburn (1886), Wright (1887).

1907. Additional notes on the development of the Argulidæ, with description of a new species. Proceedings U. S. National Museum, vol. XXXII, p. 411-424, 4 pl.

The male of *A. catostomi* is described from the redfin and blackfin suckers; also the larva of *S. maculosus* from the redeye and catfish. *Argulus appendiculosus* is described from the sucker and the development of the genus is discussed.

1908. North American parasitic copepods: A list of those found upon the fishes of the Pacific Coast, with descriptions of new genera and species. Ibid., vol. XXXV, p. 431-481, 17 pl.

Among others from marine fish are noted those from fresh-water fishes: *Lernæopoda extumescens* from humpbacked whitefish; *Actheres coregoni* from whitefish; *Lepeophtheirus salmonis* from the humpbacked salmon, *Argulus pugettensis* from the coho, *Lepeophtheirus pacificus, L. salmonis, Lernæopoda californiensis, L. falculata* from red salmon; *Caligus gurnardi, Lepeophtheirus salmonis, Lernæopoda beani* from the king salmon; *Lepeophtheirus salmonis, Lernæopoda gibber, L. bicauliculata* from Dolly Varden.

1911a. North American parasitic copepods. Part 9, The Lernæopodidæ. Ibid., vol. XXXIX, p. 189-226.

Full account of the development of *Achtheres ambloplitis,* common on rock bass and occasional on other Centrarchidæ. Infection occurs when fish feeding near surface take larvæ into mouth and expel them through gills, giving them opportunity to grasp the gill filaments.

1911b. North American parasitic copepods belonging to the family Ergasilidæ. (Paper 10.) Ibid., vol. XXXIX, p. 263-400.

Only one subfamily, Ergasilinæ, includes typical fresh-water forms. Common on bass, perch, sunfish, pike, carp; occasional on others. Full description of structure, breeding, development. Key to species and description of each with figures, record of hosts and distribution of parasites.

1911c. North American parasitic copepods. Description of new genera and species. (Paper 11.) Ibid., vol. XXXIX, p. 625-634, pl. 65-68.

Records and describes *Lernæopoda inermis* from lake herring in Great Lakes.

WRIGHT, R. R.

1879. Contributions to American helminthology. No. 1. Proceedings Canadian Institute, n. s., vol. I, no. 1, 23 p., 2 pl.

Among other parasites from various hosts he records *Clinostomum gracile* in cysts from perch, *Octobothrium sagittatum* from sucker, *Ascaris adunca* from shad, *Ancyracanthus cystidicola* from swim bladder of cisco and *A. serratus* from heart of whitefish.

1882. Notes on American parasitic Copepoda. No. 1. Ibid., vol. I, p. 243-254, 2 pl.

Reports *Ergasilus centrarchidarum* from the gills of perch, sunfish, bream, and particularly the rock bass. Also *Lernæopoda edwardsii* from gills of the brook trout and *Achtheres micropteri* from mouth and gill arches of the small-mouthed black bass. All the fish came from the vicinity of Toronto, Canada.

WRIGHT, R. R.—Continued.

1887. Argulus and mortality of fishes. American Naturalist, vol. XXI, p. 188.

Refers to Washburn (1886) and records fatal epidemic in whitefish of Lake of the Woods due to an undetermined species of *Argulus*, not the same as those from Europe where similar epidemics are not uncommon.

YARROW, H. C.

1874. Notes on the shad as observed at Beaufort Harbor, N. C., and vicinity. Report U. S. Fish Commission 1872-73, p. 453-456.

No disease has ever been noticed prevailing as an epidemic, nor do parasites as a rule infest shad; although occasionally sea lice are found hanging near the gills. They are carried into fresh waters by the migration of the shad.

DISCUSSION

MR. MEEHAN: This is a subject which interests every one of us.

PROF. L. L. DYCHE, Pratt, Kan.: I must express my appreciation of that paper. I shall be glad to see it in print. Most fish culturists know what it is to contend with a great number of diseases that we do not know very much about.

I have only been in this business a short time, but I have had to fight three or four small epidemics already; and not knowing just the nature of these epidemics made it hard to fight them. When we know what the trouble is, we stand a better show to fight it.

This fungus disease is one we do not know how to fight very well. It appears in clear water, cold water and warm water. We find it almost any time of the year in our part of the country. In planning for the new fish hatchery we go above a city, build a dam and get pure fresh water above the place where the city sewage enters the stream. It may be that a certain amount of sewage in water may be good for fish, according to some reports, from a fish food standpoint, but I doubt whether it is good for fish from a parasitic and disease standpoint. The natural process of reasoning would suggest to us that we want pure, clean water to raise fish in. The water supply of the old or present fish hatchery at Pratt, Kan., and that of a number of private ponds along the water course comes from the Ninnescah River and from a point below where the city sewage is emptied into the river. This sewage water is from a septic tank system. Yet in the ponds supplied from this water the fish have suffered from repeated attacks of the fungus diseases, and in some instances raw blood-shot places (sores) from the size of a dime to a dollar appeared on the fish, especially affecting the hickory shad and afterward the giant crappie or strawberry bass. At times these affected fish would be seen swimming near the surface of the water and resting near the shore. The dead fish would be found lodged along the shore in different places. The sick and dead fish were most noticeable along the stream and ponds directly receiving water that was affected with the sewage.

Specimens were saved for further study. In one hatchery pond stocked with giant crappie that received water direct from the river supply, twenty-seven spawners died during the spring, and many others seemed to be affected. Almost no young crappie were raised in this pond; however, the goldfish did well in the same pond, apparently not being affected with the fungus. A certain amount of sewage may help to produce food for fish, in one way or another, but on the other hand it may encourage the spread of certain diseases. I am afraid of such water for fish culture purposes.

When this paper on the diseases of fish is published we shall be anxious to read every word of it. It may help us out in certain lines, because fish diseases are appearing in different places in the state of Kansas, and we are continually receiving letters of inquiry in regard to fish that are dying from one or another described or fancied cause; and this is one of the things that has worried me as a fish culturist. After a man has spent considerable money building a pond that may contain several acres of water and has stocked it with fish, he gets nervous and excited as soon as the fish begin to die, and immediately calls upon the fish commissioner for help; and the fish commissioner may not be able to help him, not knowing how to treat or control the disease. A fish culturist is supposed to be a fish doctor.

We are planning to have a building or station costing from $30,000 to $50,000 to be used as a laboratory in connection with and on the state hatchery grounds; and people who desire to study fish and subjects connected with the fish culture business will be welcome to come and work in this laboratory. We hope to be able to furnish every advantage possible to such students. This laboratory will be under the direction and in connection with the State University. We hope to be able to help students who may be willing to come and study the diseases affecting the fresh-water fishes, such as we have in Kansas, and which same diseases are troubling fish culturists all over the country.

Mr. G. W. N. Brown, Homer, Minn.: Perhaps I have been more fortunate than most of the members present in having met a man who knew all about fish diseases. While in California I met the superintendent of a state hatchery, who informed me that he had classified 364 different, distinctive fish diseases, almost as many as there are days in the year, and had compounded a remedy for each of these diseases. Unfortunately, however, I did not have the time to take a course in piscatorial medical science. (Laughter.)

Dr. Tarleton H. Bean, Albany, N. Y.: I do not know anything in the course of a long experience in federal and state fish culture that has so much worried me as the one of fish diseases, unless it may be the interjection of politics into fish culture. (Laughter.) I do not know which is worse, for that is a disease also.

Mr. D. B. Fearing, Newport, R. I. It is hard to eradicate fungus of that character, I can tell you. (Laughter.)

Dr. Bean: In New York we have had to deal with a great variety of diseases, due not always to bacteria and to larval worms—chiefly though to these sources—as the causes of epidemics; and up to this time we have been unable to utilize to any very great extent the writings of the students of these forms of Protozoa, bacteria and worms, which lie at the root of our troubles. There is only one book so far which the practical fish culturist has been able to consult with any great profit, and that is the little book by Dr. Hofer, which, of course, every advanced student has in his library; and even Dr. Hofer has not gone far enough with his studies. In fact, the Germans who have been so patient in their researches have not gone far enough to lift us out of the hole in which we are floundering. Of course, Dr. Ward knows that better than any one else.

What we have done in New York is this: We have begged the special students to help us, and then have not waited for them to complete their studies; but we have changed our water supply wherever possible, because we realized that these troublesome little animals and plants originate usually in filth due to sewage. At one of the stations of the commission which was put out of business four or five years ago, and had been out of business practically for a great many years prior to that time, we cut out a beautiful little stream because it received drainage from manure heaps and cesspools. It had brought on what we know as the spot disease of the brook trout and the ulcer disease of the brown trout. There did not seem to be anything helpful in literature, and for that reason we cut out the stream entirely, sunk some artesian wells, and fortunately found water at a depth of 19 or 20 feet. We bought some good springs of which we controlled the heads, and since that time the station has become rehabilitated; and whereas it was difficult a few years ago to deliver to the people of New York 200,000 or 300,000 brook trout fingerlings and fry, this year the same station has been troubled to get rid of its surplus of brook trout; and the people who have received the fish have commented on the fact that they are the finest brook trout they have ever seen. It was a very simple process, of course, of a cure. The cause lies in a little creek which flowed through the hatchery ground; but we are not using it now. The same thing was done at Cold Spring Harbor, largely through the help of the Bureau of Fisheries. Messrs. Calkins and Marsh went there and told us what lay at the root of the trouble, and as they could not suggest a cure we changed the water supply there and are now drawing artesian water through three pipes, which furnish quite enough to run the hatchery.

I do not believe that a case of spot disease of the brook trout or ulcer disease of the brown trout has appeared at that hatchery for years. If there is one, I have yet to learn of it.

There is another very troublesome thing at the station in Constantia, on Lake Oneida, which should be carefully studied by bacteriologists and pathologists: I refer to the eye disease of the trout perch, small yellow perch and black bass. There is a distome which puts its larva into the vitreous humor of the eye of young fish, leading to enormous destruction of young fish of valuable species. For this we know of no remedy at present.

We are told that if we want to be rid of the larval worms we must keep the water birds off the pond; but we cannot keep them off Oneida Lake. The fish run up into the little creeks tributary to Oneida Lake, with the parasite already lodged. So that we are helpless as far as that goes.

I hope the time will come when the bacteriologist can tell us how to combat this distome and other very troublesome and dangerous animal and plant forms, so that we will not have to depend entirely on the change of water supply, because we cannot always do that. Where we have a gravity flow we cannot sink artesian wells in many cases. Massachusetts, Connecticut and Rhode Island—Rhode Island and Massachusetts especially—are so far blest by Nature in this respect that we of New York envy them; and I learn that Pennsylvania also has a feeling of envy toward any state which has artesian water, especially to be had at such moderate depths, which can flow into its troughs and hatcheries; because artesian water properly meandered and brought into the troughs and ponds is the best water in the world; and it is the only water, except pure spring water, which is not always obtainable, upon which we may rely to be rid of these causes of the terrible epidemics which have swept away thousands and tens of thousands of dollars invested in state and governmental work.

TREMATODE PARASITES IN THE SKIN AND FLESH OF FISH AND THE AGENCY OF BIRDS IN THEIR OCCURRENCE

By Edwin Linton

In this paper it is my purpose to discuss briefly a few cases of parasitism due to trematodes, confining my remarks to one form which occurs encysted in the flesh of certain fresh-water fishes, and to a few cases of cysts in the skin of fresh-water and of marine fishes.

LIFE-HISTORY OF VERMIAN PARASITES

It is a fact well known to students of zoology, though not so well known to those unlearned in that science, that the group of vermian parasites belonging to the flatworms makes use of two or more animals in completing the round of life. An animal that acts as a place of lodgment of a parasite is known as a host. In one of these animals the parasite is in the larval stage, in which case the host is said to be intermediate; in the other animal the parasite is mature and produces eggs, its entertainer being then called the final host. There are cases known in which one and the same animal may act as both an intermediate and a final host for the same parasite. In such cases the acquisition of the larval stage of the parasite is accidental and exceptional. Somewhere between the chain of events which links together the various stages in the life-history of any parasitic flatworm an intermediate host, together with its larval parasites enclosed in cysts in its tissues, has been eaten by another animal, usually the final host. And, invariably, as the last link to the chain, the final host has swallowed the larval or immature form which has inhabited one or more intermediate hosts before it has attained its final resting place.

In the order of flatworms known as cestodes or tapeworms, the relation between the intermediate host or hosts and the final host is direct, and may be characterized by the words eater and eaten. Such, for example, is the relation between the hosts of a small tapeworm (*Otobothrium crenacolle*), which is adult in certain species of shark, and is found encysted in a large number of our bony fishes, notably in the common butterfish (*Poronotus triacanthus*), where it is encysted, sometimes in enormous numbers, in the muscles. (During this past summer I removed 7,932 cysts from the muscles of a single butterfish.) Another, which brings together a bird as the eater and a fish as the eaten, is that of a tapeworm (*Dibothrium cordiceps*), larval in the Rocky Mountain trout and adult in the white pelican.

Indeed, birds and fishes, in the economy of nature, have long been associated as eater and eaten, and it should not be a matter of surprise, therefore, that fishes should be intermediate hosts of many parasites whose development into adult, egg-producing worms depends upon their entering the alimentary canal of some bird.

Not only cestodes, or tapeworms, but trematodes, or flukes, as well, are known which have fishes for their intermediate hosts and birds for their final hosts. The life history of trematodes, however, is more complicated than that of the cestodes, in that an invertebrate, usually a mollusc, serves as one of the intermediate hosts. One of the few examples of trematode life-histories which have been worked out is that one, now become a classic, furnished by the liver fluke of the sheep (*Fasciola hepatica*). It is scarcely possible to give a satisfactory synopsis of this life-history without figures and the use of technical terms. Briefly it is as follows:

The adult flukes live in the biliary ducts of the sheep's liver. The eggs pass readily into the intestine and thence, along with the fæces of their host, to the exterior. Falling in moist places there hatch out from the eggs ciliated embryos of microscopic size, 1/200 of an inch, more or less, in length. They live for a time in the water swimming about actively. Coming in contact with a species of fresh-water snail they enter its pulmonary chamber, where they become fixed, lose their cilia and are transformed into a more or less irregular mass called a sporocyst. In the interior of a sporocyst there develop, from masses of cells, small worm-like structures provided with a mouth, a pharynx, and a straight intestine. These structures, called rediæ, leave the parent sporocyst and invade the liver of the snail. There they develop further and there is differentiated within them a more or less considerable number of young flukes. These differ from the adult form in the rudimentary character of their reproductive organs and, usually, in having a long tail. They agree with the adult form in having both an oral and ventral sucker and a forked intestine.

These young flukes are called cercariæ. They are exceedingly active, and in form and movement suggest tadpoles. In the tails of cercariæ which I found at Woods Hole this summer (1911) striated muscle fibres were very distinctly shown. Upon escaping from the parent redia the cercaria of the liver fluke lives for a time in water. After it has abandoned its host the cercaria creeps upon the surface of vegetation, where it secretes around itself a transparent cyst, losing its tail during the process of encystment. Sheep or cattle, or, accidentally, man, eating vegetation on which these cysts occur, may thus become the final host in which the young distome develops to maturity after finding its way into the bile ducts of the liver, where it produces eggs, and the round of life is completed.

In passing, it may be worth while to note the enormous number of individual flukes that might develop from a single egg. Thus the egg gives rise to one ciliated larva, and the larva to one sporocyst. The number of rediæ which may develop within a single sporocyst varies considerably within the same species. Furthermore, more than one generation of sporocysts or of rediæ may appear before the cercariæ are produced. On the other hand the redia stage may be omitted altogether. Sporocysts which I have found thus far in marine invertebrates produce cercariæ directly without the intervention of a redia stage, and, in one case, the cercariæ are without tails, thus indicating that they pass to the final host directly when the intermediate host in which they are lodged is swallowed by the proper animal. From 25 to 50 or more cercariæ may be counted in sporocysts which I have collected from molluscs and an annelid worm at Woods Hole. If rediæ are produced in like numbers in cases where that stage appears, then the number of cercariæ which may arise from a single egg might be the last term in a geometrical progression in which the first term is one, the number of terms at least three, and the ratio as much as 50, or even more. This would be interpreted as 1 egg, ciliated larva and sporocyst, 50 rediæ, and 2,500 cercariæ. In cases where another generation of sporocysts or of rediæ appears, another term, or perhaps two would be added to the progression.

A FLESH PARASITE OF THE BLACK BASS AND OTHER FRESH-WATER FISHES

In a recent contribution to the Biological Bulletin (vol. xx, p. 350-366), Prof. H. L. Osborn has brought together the literature on an interesting distome of wide distribution. It has been recorded under a variety of names by different observers but the name which seems to have priority is *Clinostomum marginatum.* This distome has been described and recorded by several observers from a variety of hosts. In the larval or encysted stage it has been reported from the yellow perch, striped bass, two species of sunfish, the small-mouthed black bass, a silurid fish, and at least one species of frog. The localities from which it has been reported are Kansas City, Mo.; Montreal, Ontario; Nebish, Mich.; Philadelphia, Pa.; Porto Rico; St. Paul, Minn.; Toronto, Ontario; Troy, N. Y. In most cases the seat of infection is in the muscles, but it was also found in the gills, the branchiostegal membranes, the fins, and the mouth. More than ordinary interest attaches to this worm from the fact that we have here a parasite which infests portions of the fish that are used as food. Osborn reports that at Nebish, Mich., in

1901, he found it in nearly all the bass that were submitted to him for examination, while in the perch it was much more rare.

He thus describes the appearance of these parasites in the flesh of the fish:

> The cysts were very easily seen, being large, opaque and very creamy white, in marked contrast with the darker semi-translucent muscular tissue in which they lie embedded. When the fish were skinned in preparation for cooking the cyst walls were often torn open and the conspicuous worm seen moving on the surface of the meat. The cysts were found in all parts of the lateral muscles, deep and superficial, dorsal and ventral and headwards and tailwards. * * * The number of cysts in single individuals varied greatly. The minimum number found was seven and the maximum more than one hundred.

To the above localities and hosts of this parasite I am able to add another. In June of this year I found this distome in the brook trout of Alder Lake, Delaware County, N. Y. As this is the first record of the finding of this parasite in the trout I shall insert here a brief account of it.

The trout were not found to be badly infested, the distome being seen in only 17 of the 70 trout which I examined. No trout was found with more than 4 cysts in the flesh. Nine trout had 1 cyst each, seven had 2 cysts each, and one had 4 cysts. These worms were found in the larger trout. Thus 16 of the 17 parasitized fish were over 8½ inches in length. Of the 70 trout examined 47 were 8½ inches or over in length, and 16 of them had cysts in the flesh; 23 were less than 8½ inches in length and only one of them was parasitized, it having 1 cyst in the flesh. The greater number of trout examined had been caught at the surface with the fly. On June 27 I examined 5 large trout from 9 to 10 inches long which had been caught with bait at the bottom. Each of these fish was parasitized having 1, 2, 2, 2 and 4 cysts in the flesh, respectively.

The cysts are easily seen, being usually slightly yellowish on account of the orange or salmon color of the contents of the intestinal tract of the enclosed distome. They were found in several locations, viz., in the vicinity of the first dorsal fin, in front of the caudal fin, near the base of the anal fin and between the pectorals. Usually they lay deep in the muscle tissue near the supporting spines of the fins, though a few were found in the muscles but a little below the skin, and a few near the peritoneal lining of the body cavity. All were embedded in the muscle tissue. Of the 27 cysts that were found, 19 were in the vicinity of the first dorsal fin, 15 of them lying deep in the muscles and near the supporting spines of the fin, 2 near the exterior and 2 near the interior of the body wall; 4 were found deep in the muscles in front of the caudal fin, 2 were near the pectoral fins, and 2 near the supporting spines of the anal fin. In all cases the cysts were thin walled, so much so indeed that the distomes usually liberated themselves by their own exertions when the cysts were placed in water.

The distomes vary in size and are remarkably contractile. One of the larger specimens when removed from its cyst and placed in water was very active and varied in length from 3 to 10 millimeters. The neck in particular was very contractile, shortening until it was but a nodule and lengthening until it was slender and thread-like. The body was flat and leaf-like and the intestines were salmon color. In a lot of these distomes mounted in balsam the smallest is 3½ millimeters long, 1 millimeter broad, and the largest is 7½ millimeters long and 2 millimeters broad. In all cases, whatever the size, these distomes showed about the same stage of development, which was sufficiently far advanced to admit of specific determination, so that one can confidently refer them to the species found adult in the mouth and pharynx of the heron and the bittern.

Prof. R. Ramsay Wright, in 1877, reported a distome from the bittern (*Botaurus minor*). The worms were found in the mouth at the sides of and below the tongue. MacCallum, in 1897, reported the same worm under a different name from the heron (*Ardea herodias*). Both of these hosts were obtained in Canada. Osborn in this current year

(1911) also reports this distome from a heron sent to him from Nebish, Mich. Although the bird had been dead a day or two, he found the worms still alive in considerable numbers adhering to the wall of the throat by means of the anterior end used as a sucker.

Upon comparing the distome from the flesh of the trout with published figures and descriptions of this adult form from the bittern and the heron it is evident that they are one and the same species.

Since it is possible to identify the species with such a degree of confidence, we are furnished with a clue to the source of infection of the trout of Alder Lake. Heron are not infrequent visitors at the lake, and the distomes now infesting the flesh of the trout in these waters, with little doubt, owe their existence to eggs which were introduced into the waters of the lake along with the excreta of some infected heron or herons which have visited the lake sometime within the past year or two. It should be stated that the worms were first observed in the flesh of the trout by Mr. L. F. Bliss, steward of Mr. S. D. Coykendall, the owner of the preserve upon which the lake is situated, in the autumn of 1910.

Trout are, as a rule, exceptionally free from parasites in the flesh. It is therefore worth while in a paper of this kind to consider the reasons for the exceptional occurrence of this distome in the trout of Alder Lake. It is to be noted that while the conditions under which the trout are living in this lake are not unnatural they are unusual. The level of the lake has been raised by a dam at the outlet over which trout cannot make their way from the stream below. To find a similar condition in nature where fish are living in a lake to which they are confined, that is, where they cannot move freely to and from the lake by means of the outlet, one must go to such a lake as Yellowstone Lake. It is of interest to note that in that lake the trout are likewise infested with a parasite in the flesh, and that the parasite is an immature cestode worm which reaches its adult stage in a bird, the white pelican. It is manifest that fish thus confined to a lake are more exposed to infection than they would be if they spent all or even a part of their time in a running stream. Furthermore, the fish in a private preserve, being in large measure protected, would have a longer expectancy of life than fish living under similar conditions but without this protection.

The portion of the life-history of this flesh parasite of the trout which is comprised between the egg and the worm as it is found in the flesh of the trout is unknown. While at Alder Lake I examined a considerable number of snails and found rediæ in one species (*Planorbis trivolvis*). In each of these rediæ there was a large number of a very peculiar cercaria, a description of which must be left for a more technical paper than this. It is not possible at present to say to what species of distome these rediæ and their contained cercariæ belong.

Certain economic questions that are suggested by this flesh parasite are considered in the concluding section of this paper.

SKIN PARASITES OF FRESH-WATER FISHES

If one will take the trouble to examine closely the skin and the fins of a considerable number of fishes in certain localities he will be pretty sure to find a number of small spots of black pigment which, upon still closer examination, will reveal a small cyst in the midst of it. When this cyst is viewed with the aid of a compound microscope a young trematode may be discovered folded away within its walls. I have had sent to me from various localities specimens of the small-mouthed black bass upon which I have found these cysts. Following are brief notes made on two fish sent to me by Mr. C. W. Nash, of Toronto, Ontario, October 4, 1909:

Each of the fish had a few black pigment spots on the fins and one of them had a few also on the body, cheeks, and under side of the head. Upon opening the fish along the back and stripping away the skin a few black pigment spots were found similar to those on the fins. Some of these, being in the dermis, adhered to the skin, others were in the muscle tissue although none of them lay deep in the muscles. All of them could be seen on the side of the muscle mass that had been next the skin. These pigment spots were rather more abundant along the back and on the posterior half of the body of the smaller fish, although they were also found in the muscles near the gill opening and in the pectoral muscles. About 53 were found in the flesh, and a few on the gill arches. In the larger fish the distribution was much as it was in the smaller specimen. There were about 30 cysts, mainly on the sides in the middle region, one being found in the muscles at the depth of 4 millimeters. Each cyst that was examined contained a larval trematode. So far as they were studied they were found to suggest the form described by Leidy under the name *Diplostomum gracile*, although one of them which was removed from the cyst and stained and mounted in balsam was thought to suggest the genus *Holostomum*.

In July, 1905, I spent one day at Alder Lake examining the brook trout for skin parasites. A description of conditions as they then existed has already been published (International Zoological Congress, 1907). While none of the trout had large numbers of cysts in the skin a large proportion of them were infected. A few had as many as 20 or 30 cysts visible on one side, some had none, others had from 1 to 5 on one side. Upon that occasion the owner was advised to discourage the visits of fish-eating birds to the lake as much as possible. This advice was followed. Upon my visit to Alder Lake this summer, after an interval of six years, I found the skin parasites of the trout less prevalent than they were in 1905. Of the 70 fish examined nearly half were without any cysts whatever.

I was not able to refer the larval distomes found in 1905 in these trout with certainty to any genus with which I was acquainted, although the genus *Diplostomum* was suggested.

This season my time was occupied with the flesh parasite, and I examined barely half a dozen of the cysts. In each case I found the cyst to be exceedingly thick walled and the contents degenerated to an indistinguishable granular mass.

While the generic identity of these encysted trematodes was not definitely ascertained, sufficient was revealed by their structure to indicate that they belonged to that group of trematodes whose adult stage is passed in the alimentary canals of fish-eating birds.

Hofer, in his *Handbuch der Fischkrankheiten* (Munchen, 1904), discusses such cases as these under the caption, "Die Diplostomumkrankheit or Diplostomiasis." These cysts have been recorded in a number of the European fresh water fishes. Their usual situation is in the skin, although at times they are found in the outer muscle layers beneath the skin. The encysted worm represents the larva of a trematode which is known under the name *Diplostomum* or *Holostomum cuticula*. Hofer's description of the appearance of these cysts in the skin of fishes is in practical agreement with what I have observed in the fishes that I have examined in this country. In the trout the presence of these skin parasites was indicated by black specks which upon narrow scrutiny were seen to consist of an accumulation of black pigment around a transparent cyst which is often silver white and shining like a small crystalline lens. This cyst usually lay just beneath the epidermis and projected slightly so that the surface containing a number of them presented an embossed superficies which could be detected by passing the hand lightly over it.

While the life-history of these parasites of fresh-water fish has not been worked out and must of necessity be conjectural, it may be said that there are the best of reasons for believing that they are due to eggs which have been discharged into the water along with the excreta of birds, and no reasons for believing otherwise. Of course, it is possible that the cercariæ of distomes whose adult stages are found in fishes and amphibians might become encysted in the skin of fishes, but thus far the worms from these cysts that have been recognized have been forms whose round of life is completed in the alimentary canals of birds. As the case now stands, therefore, concerning the source of the trematode parasites in the flesh and skin of our fresh-water fishes, that source is to be found in certain fish-eating birds.

A SKIN PARASITE OF CERTAIN MARINE FISHES

In a report on fish parasites collected at Woods Hole in the summer of 1898, I noted the occurrence of cysts in the skin of the cunner *Tautogolabrus adspersus* (Bull. U. S. Fish Commission, vol. XIX, 1899, p. 296, pl. 40, fig. 76-81). These cysts had been made the subject of a paper by Ryder (Bull. U. S. Fish Commission, vol. IV, 1884, p. 37-42), who attributed the cysts to cercariæ. Later I recorded similar cysts from the tautog (*Tautoga onitis*) (Bull. U. S. Fish Commission, vol. XIX, 1899, p. 463, pl. XXVIII, fig. 38). Since then I have found these cysts in the skin of a number of fishes in the Woods Hole region, but in none so frequent nor so abundant as in the cunner and the tautog. As it is my purpose to prepare a special report for the Bureau of Fisheries on the skin parasites of fishes I shall reserve further details of distribution for that paper.

In my report on cysts from the skin of the cunner I regarded these trematodes as distomes. Since that time—and especially this summer—I have removed a number of them from cysts, and, while I find them in agreement with my published figures, I also find that I misinterpreted one structure. In my figures a ventral sucker is indicated. Now this structure was not clearly defined, and perhaps should have been represented in a slightly different manner in the diagrams. A rudiment of a sucker-like organ is undoubtedly present, but instead of being a true ventral sucker it more probably represents the genital aperture characteristic of the family Siphoderidæ (Trematodes of the Dry Tortugas, Linton, 1910).

It was not until the present summer that this puzzling rudiment was understood, when the adult stage was found in the loon.

The prevalence of this form of parasitism among the cunners and tautog from certain localities is very great. Neither is it unusual to find individual cases of extreme abundance. In badly infested fish, not only the fins but the entire surface of the body, including the cornea of the eye, is thickly peppered with the cysts. Whenever a fish is thus badly infected the prevailing color is blue. Some idea of the great numbers of these cysts in extreme cases may be gained from the count given for the corneas of a tautog, one of the corneas being figured in the report cited above. The count showed 74 cysts in the cornea of one eye and 81 in the cornea of the other.

It is not at all improbable that a systematic study of these cysts will reveal trematodes of different species. So far as my examination has gone I am sure of only one species.

While examining a loon at Woods Hole on July 24, 1911, I found a very large number of small trematodes in the intestine which resembled the forms which I have obtained from cysts in the skin of the cunner and other fish of the Woods Hole region. Among them were young forms without ova. When these are compared with larvæ from the dermal cysts of the cunner the identity is established beyond doubt. Both are characterized by the same kind of oral sucker, pharynx, esophagus and intestine. The outline is similar in each and the surface of each is covered densely with very minute spines of like appearance. Instead of a ventral sucker a genital sucker is present in the adult. This median genital sucker made clear a heretofore baffling rudiment in the encysted larvæ which had been interpreted, not with entire satisfaction, to be the ventral sucker of a distome. A few examples of larvæ from cysts were obtained in which the rudiments of the testes and ovary could be distinguished, and were seen to occupy the same relative positions which they hold in the adult worms.

In collecting these trematodes from the loon, a portion of the intestine was scraped, the scrapings washed and the water decanted. The worms, then seen for the first time, were collected from the bottom of the dish. As their presence was not suspected until the material had been washed, no effort was made to remove all the worms that might be lodged in the mucous membrane of the intestine. Notwithstanding this, 4,789 specimens were counted. They presented a great variety of contraction shapes, but at rest they were usually long oval, widest at about the level of the posterior edge of the genital sucker, or a little back of that point, tapering most toward the anterior end. Some were nearly linear from the genital sucker to the anterior end, with the posterior portion broadly rounded; others were nearly linear throughout. There is considerable variation in size, though all are small, being less than 1 millimeter in length when uncompressed. One measured 0.75 millimeter in length, and 0.35 millimeter in greatest breadth; ova 0.04 by 0.02 millimeter. Further details will be given in a special report.

ECONOMIC CONSIDERATIONS

Since the thought of the presence of parasitic worms in our foodstuffs is such a disquieting one, this paper should not be brought to a close without at least a brief consideration of the insistent inquiry respecting the harmfulness to man of these parasites and of the question of their control, or extermination.

So far as known there is no danger that any of the parasites considered in this paper will develop in man. When it is remembered that the infected fish are eaten by a large number of other fish, in which these parasites do not come to maturity, and that even among the fish-eating birds the adult of the flesh parasite has been found in only two species, the bittern and the heron, and that the adult of the skin parasite has been recognized in but one species, the loon, the chances that they would develop in so widely different a host as man are very remote indeed.

With respect to the skin parasites it will readily be seen that most of them are removed in the preparation of the fish for the table, so that the chances of any of them entering our food are not great. It may be a quieting thought also to remind those interested that the flesh parasites would hardly escape the notice of a careful cook. To all this it may be added that since we in this country prefer to have fish well cooked when it is served as food, the danger of infection from this source is reduced to a minimum even if the parasites were capable of continuing their development in a mammal host, and that mammal the genus man.

Nevertheless if the parasites are not injurious to man in a pathological way their presence in our food is still most objectionable. Indeed their presence in any considerable numbers in an occasional fish, or in any considerable proportion of fish, aside from the direct injury which they may inflict on the fish, will, of course, render them undesirable if not actually unfit for food.

It should be borne in mind that neither the flesh parasite nor the skin parasite can multiply in its encysted state. Their only chance of attaining the adult egg-producing stage of existence is that they with their host be eaten by the particular kind of animal to whose alimentary canal they are by long adaptation and selection suited. Their prayer is for a suitable and timely devourer.

Since the original source of infection for both the flesh parasites and the skin parasites that are made the subjects of inquiry in this paper is found in a fish-eating bird, the control of both can be considered as one question.

Where fish are confined to ponds or small lakes the question resolves itself into the practical one of excluding fish-eating birds from small bodies of water. While such exclusion may not always be practicable, the infection of the waters may be in great measure prevented by vigilance in shooting objectionable bird visitors.

In large bodies of water or in the open sea, the problem becomes a more difficult one. And yet, even in such places, it is not incredible that some check is possible for these forms of parasitism.

There has been and is much laudable zeal displayed in the enactment of laws for the protection of birds. I hope that I shall not be misunderstood when I suggest that this zeal might be allowed to suffer some abatement, especially with respect to fish-eating birds. Surely the fish are deserving of some consideration as well as the birds, and man's comfort and well-being are still of vital interest and importance.

THE ABSORPTION OF FATS BY THE ALIMENTARY TRACT, WITH SPECIAL REFERENCE TO THE FUNCTION OF THE PYLORIC CŒCA IN THE KING SALMON, ONCORHYNCHUS TSCHAWYTSCHA.*

By Charles W. Greene

In an investigation of the distribution of fats in the king salmon, *Oncorhynchus tschawytscha*, pursued during the summer just closed, I have examined the various tissues and organs of the salmon including the different divisions of the alimentary canal. For the present purpose, omitting a review of the entire gross anatomy of the salmon, I will call your attention at once to the alimentary tract.

Description of alimentary tract.—The alimentary tract of the salmon is a very simple S-shaped tube. The only divisions of the tube are the stomach and the intestine with its appendages and glands. The first limb of the *S* is represented by the cardiac division of the stomach, the middle piece by the pyloric end of the stomach and the pyloric division of the intestine, and the last limb of the *S* by the long straight portion of the intestine ending in the rectum.

The most striking characteristic of this alimentary tube is the presence of the enormous number of diverticula, the pyloric cœca. The number of cœca in the king salmon varies from 140 to 185 as given by Jordan and Evermann in "Fishes of North and Middle America."

The cœca look like numerous rather large but slender worms attached to the pyloric division of the intestine. They are blind tubes varying in length from 10 to 13 cm. for the longest, down to 1 cm. for the shortest. The long cœca are at the beginning of the pyloric intestine and the short cœca at the other extreme of the pyloric region. The cœca vary in diameter from 0.5 to 0.8 cm.

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The thickness of the cœcal wall and the diameter of the cavity within vary according to the degree of distension of the tube.

The detail of the histological structure is comparable to that of the intestinal tube of which the cœca form diverticula. The cœcum is covered with peritoneum and lined on the inside with a simple layer of mucous epithelium much folded. Listing all these coats and naming the parts from without inward they are: The serous coat, the longitudinal and circular muscular coats, and the mucous coat, consisting of the tunica propria, the stratum compactum and the mucous epithelium.

Method of observation.—The method used for the examination of the amount and histological distribution of fats was the newer modification of the Herxheimer method for staining fat with scarlet red, a method which has been recently improved and used with much success by Prof. E. T. Bell, now of the University of Minnesota, and his assistants. By this method portions of fresh tissue, or material that has been for a short time in ten per cent formalin, are sectioned by the freezing microtome method, transferred into seventy per cent alcohol, stained with alkaline alcoholic solution of scarlet red, and mounted in pure glycerine. Preparations sealed with paraffin keep more or less perfectly for a few weeks only.

Observations and hypotheses.—During the examination of the different tissues of the king salmon taken off the feeding grounds at Monterey Bay, Cal., it was noticed that varying quantities of fat droplets were always found in the pyloric cœca. The fat was located always in the epithelium and in that portion of the mucous coat described as the tunica propria. In certain preparations immense quantities of fat droplets were crowded into the cells of the epithelial coat. This loading of the epithelial cells with fat formed indeed a very striking picture. However, in sections prepared from different animals, and, in fact, often in different regions of one and the same section, the loading of fat in the epithelium varied greatly in amount. The variation was so great that the question was immediately raised as to the source and nature of this fat.

Two hypotheses are possible in explanation, first, that the fat droplets were present merely as storage fat. If so it could legitimately be expected that the fat should have an even distribution through the various portions of the epithelial coat of the cœcum, also that there would be some uniformity of distribution in the different cœca of one and the same fish even though there might be variations in different fishes. The facts did not correspond with this expectation, as the previous statements have already indicated.

The second hypothesis in explanation of the facts observed is that the epithelial fat was in process of absorption. This hypothesis was supported, first, by the fact that the salmon under observation were feeding salmon, the food consisting of the Crustacea, molluscs, and other fishes of the region, many having a high percentage of fat in their composition. Furthermore, if the epithelial fat were absorption fat it certainly would vary in amount in different portions of the coat. Those portions of the epithelium in which adjacent folds are in contact would receive a relatively small amount of fat for absorption. Those portions of the mucous coat extending in folds well out into the middle of the lumen of the cœcum would naturally have a better contact with the food than the deeper portions just mentioned and have access to more fat.

The relation of the mucous epithelium to the other portions of the cœcal structure can be seen in the sections showing fat absorption. Highly magnified portions of the epithelium show the cells charged with fat. In some preparations the free ends of the epithelial cells are filled with relatively large sized fat droplets in that portion of the cell nearest the nucleus. In the extreme distal ends of the cells of these sections the fat is in very minute droplets, discernible only with the oil immersion lens. The material also shows a transparent striated border which is more or less characteristic of intestinal epithelium in general. The basal portions of the epithelial cells have a relatively small quantity of fat in medium sized droplets. The loading of the cells is great in the distal ends and slight in the basal ends, as is readily seen in numerous preparations. In the connective tissue stroma, between the two folds of the epithelium, fat is present in relatively small amount and in the form of comparatively large droplets. In contrast with this stage in absorption is that in which the free ends of the epithelial cells are practically free of fat, while the basal portions of the cells are crowded full of extremely finely divided fat. The submucous zone, or stroma, has a relatively large amount of fat in small droplets. Considering the two showings together one cannot escape the conclusion that we have to deal here with two stages of fat absorption rather than with a problem of fat storage.

In material taken from the sea fish, as shown in the above cases, one has neither choice nor accurate knowledge of the stage of feeding represented by a given individual. However, I attempted on the basis of the amount and stage of digestion of the food present in the stomach and intestine, to select salmon representing possible stages in the process of fat absorption. A series of three salmon were procured, all with considerable food in the alimentary tract—one with slight, one with medium, and one with advanced stage of liquefaction of this food. A microscopic examination of the pyloric cœca of this series tended, with some degree of uncertainty, to confirm the assumption made in their selection, namely, that they would show increasing amounts of fat in the mucous epithelial cells as digestion and absorption proceeded.

While these observations were in progress, at the invitation of Dr. Charles H. Gilbert, of Stanford University, I visited the Santa Clara County trout hatchery at Brookdale, Cal., that I might secure samples of young salmon for comparative histological purposes. The station had on hand some two-year-old salmon; also some yearlings. Specimens of both were secured, killed and prepared for comparison with the adult fish in points with respect to the general study being pursued. I also transported living specimens of these salmon in fish cans to the Hopkins Seaside Laboratory at Pacific Grove, Cal. These young live salmon were intended for use as a check on the general fat content of adult salmon secured through the Monterey fisheries. A microscopic examination of the tissues of one of the largest of these specimens showed among other things that the intestine and the pyloric cœca contained neutral fat, but that the fat was located chiefly in the tunica propria. The cells of the epithelial coat were almost entirely free of fat in this specimen. A second specimen, put in preservative at the Brookdale station, showed a small amount of fat in the epithelial coats of the intestine and the cœca. This dearth of fat in the epithelial coats of the young salmon was in sharp contrast to the relatively large amounts of fat always found in the epithelium of the cœca of the adult salmon.

Experimental test of the fat-absorbing power of the pyloric cœca.—It was determined to make a test of the fat-absorbing properties of the pyloric cœca on the young king salmon, for which purpose two of the larger salmon and four of the smaller ones were still available. The two larger salmon were 14 and 16 centimeters long respectively. These young fish had not been fed since removal from the Brookdale aquarium, so that the alimentary tracts were assumed to be practically free from fat, an assumption checked by the specimens previously examined.

The salmon in the experiment were fed olive oil. The attempt was made at first to give olive oil mixed with enough coagulated milk to hold the oil in the semi-solid mass of the milk curd. This mixture was injected through the mouth into the stomach by means of a syringe with large opening. But quantities of the milk coagulum were immediately ejected by the salmon when set free and one could not determine whether any of the oil was retained. The specimens were therefore immediately fed pure olive oil, this time by way of the rectum.

A small quantity of oil was taken into a medicine dropper, the glass point of which had previously been drawn out to the proper size. The tip of the dropper was then inserted through the anus into the rectum and the oil gently injected until it was judged a sufficient quantity had been used to fill the small intestine as far forward as the pyloric division. Of the larger salmon one received a relatively large quantity of oil, the other a smaller quantity. Of the small salmon no attempt was made to differentiate them as regards the quantity of oil used.

All the fish were in good condition, were sprightly following the giving of the oil, and they remained so until they were killed in the experiment. The first specimen, no. 45, 14 centimeters long, was killed after 19 hours. The second specimen, no. 46, was killed after 42 hours. The smaller fish were used as corroborative material and were killed at later periods.

Detailed results of the Brookdale salmon fat-feeding experiment.—The young salmon, no. 45, was killed by cutting off its head. The alimentary tract was carefully removed and portions of it examined perfectly fresh, other portions were fixed in formalin, and still other portions in solutions preparatory to paraffin sectioning. The fresh material was frozen and cut on the Bardeen freezing microtome. The sections were cut into seventy per cent alcohol and were immediately after stained in alkaline scarlet red. Formalin fixed sections were also stained for fat. Later paraffin sections were made for the study of structural details.

The cross sections of the pyloric cœca of the young 14 centimeter salmon show a comparatively simple folding of the mucous epithelium, also the stratum compactum seems relatively undeveloped and the cœca are correspondingly small. Aside from these facts the cœca have a structure comparable to that of the adult salmon.

The epithelial layer of the cœcum of this salmon fed 19 hours before with oil was found to be simply crowded with fat droplets. With the low power magnification this coat in which the fat is stained with scarlet red is so full of oil that it appears of almost a uniform scarlet color. In the portions of the epithelial coat lying nearer the deeper grooves in which the adjacent mucous surfaces are more or less in contact, thus preventing free contact with the fat within the lumen of the cœcum, the epithelium was not always filled with fat. This fact was more prominent in the more sparingly fed fish no. 46. In other words, considering the picture as a whole, it was found that there was not a uniform filling of the epithelial cells with fat in all portions of the cœcum. In those portions of the epithelium in which the sections showed the presence in the lumen of the cœcum of large quantities of free fat in close contact with the epithelial coat, the coat itself was so gorged with fat droplets as to make it difficult to determine the cellular outlines. In fat-stained frozen sections that were counterstained with hæmatoxylin the nuclei are shown as a layer at about the basal third of the cells. At the stage in the process of absorption represented by no. 45 the greater masses of the fat are in droplets in the outer two-thirds of the epithelial cells. In this young specimen the fat drops seem unusually large, much larger than those observed in the ordinary course of absorption shown by the pyloric mucous epithelium of adult fish caught in the sea. The bases of the epithelial cells in those regions where active absorption is taking place contain fat droplets, but the droplets are smaller and not so numerous. Also, in such regions fat was found to have penetrated into the tunica propria where droplets of considerable size are distributed along the strands of connective tissue of the tunica. The fat droplets in the tunica propria are comparatively numerous in the three experimental specimens of this group. On the whole, the amount of fat in this region was considerably increased over that in the normal animal. Different portions of the tunica propria are not uniformly charged with fat droplets. The fat extends down to the stratum compactum, but not beyond in any case. It seems that the stratum compactum acts as a definite bounding membrane to the mass movement of the fat in the submucous layer. Apparently the fat is taken from this region by some mechanism acting through the agency of the circulatory system.

Various sections of the pyloric cœca revealed the same general picture of the passage of fat droplets through the mucous epithelial coat that has previously been described for fish no. 45. The fat was present in surprisingly large drops in the outer layer or zone of the epithelial cells. It was also present in the basal portions of these cells and present in considerable quantities in the underlying tunica propria.

The intestinal tract in all the regions of no. 46 examined showed fat in process of absorption through the mucous epithelium.

One individual of the smaller sized salmon was examined with reference to the fat absorption. It showed a picture structurally comparable to that of the larger salmon. The very small diameter of the pyloric cœca renders their examination relatively difficult, yet the details of the distribution of fat in the mucous epithelium can only be interpreted as confirming the deduction made from the two larger specimens, *i. e.*, that *the fat fed in these experiments was being actively absorbed by the pyloric cœca and the intestine.*

DISCUSSION

Dr. H. B. Ward, Urbana, Ill.: I would like to ask a question. Do I understand that you used salmon that had passed out of salt water into fresh water, or were they king salmon still in salt water and feeding?

Dr. Greene: The first experiments were on naturally feeding salt-water king salmon: the experiments in which I myself fed the fish artificially were on young king salmon that had not yet gone into salt water—some of them were two and some one year old.

Dr. Ward: Have you tried this on fish after they leave salt water, so that you can say whether there is any absorption?

Dr. Greene: That question I suspect does not mean as much to some of the gentlemen present as it does to the gentleman who asked the question. Those who are familiar with the situation know that the king salmon do not eat after they leave salt water on their return journey to the fresh waters for spawning purposes. A still larger number do not know that in this fasting journey there is a marked retrogression in the whole alimentary tract. That is a problem I have been working on and I now have a considerable mass of scientific material tending to show that this tract not only markedly degenerates in size, but changes in a very profound way in histological structure. These changes in structure practically answer the question.

One would not expect the salmon that have undergone the extreme changes to show the same absorbing power that the young salmon do that were eating but had not yet gone to sea; or that the old salmon still eating and in the sea show. The fact is that the epithelial coat of the cœca has practically disappeared. I have histological sections of material of far-changed spawning salmon in which there is no epithelial coat present either on the cœca or on the intestine. So, of course, in such cases absorption would be wholly different from the normal absorption of food material.

Dr. Ward: Taking them about the time they stop feeding, can you keep them absorbing longer than they otherwise would? In other words, does the stoppage of absorption follow the stoppage of feeding; or does the stoppage of feeding become associated with the tendency to degenerate in the alimentary canal? Which is the primary and which is the secondary feature?

Dr. Greene: I have not made those tests and do not think I can answer the question. It is a factor that is too much involved in certain physiological processes to be directly determined by histological evidence alone. It is also very difficult to detect the moment when the normal structure begins to change over to this special degenerative structure. I suppose that in the earliest stages of this change the tissue, having already entered a pathological state, may still be capable of absorbing, though I doubt it. I do not know; I am only guessing at that. I cannot guess with assurance in our present state of knowledge.

The interesting factor behind these questions asked by Dr. Ward is this factor of degenerative change, not only in the alimentary tract but in all other parts of the body save one, the reproductive organs, during the migration from the feeding grounds of the sea back to the spawning grounds. This is one of the most interesting of biological facts, as far as its physiological bearing is concerned. I am personally of the opinion that the cessation of feeding, therefore of absorption, and the broad changes in the skin, muscles, etc., are all expressions of the one physiological condition that culminates in the spawning process.

The latter part of the presentation of my paper seemed to me very inadequate, a matter that will be adjusted by the publication of the paper itself, but I want to raise one question of general bearing in reference to physiological work in the study of fishes. I know that this Society has long since emphasized questions in relation to fish foods, environment for fishes, also the economic side of the production of large quantities of fish. To me many of those problems have a possible solution in a better knowledge of the physiological functions of fishes, as is true, of course, of that more remote complex of factors which result in the infection of fishes, thus leading to abnormal functional states.

It is obviously as important to understand the ability of the fish to utilize food as to understand the ability of the fish to catch food. I do not mean, however, to discuss this point any further than merely to call attention to it.

THE PRIBILOF FUR SEAL HERD AND THE PROSPECTS FOR ITS INCREASE

By C. H. Townsend

After more than twenty years of active operation, the pelagic sealing industry has been brought to an end, as the result of an international conference which has been held at the Department of State. The convention has been signed by representatives of the United States, Great Britain, Russia and Japan, and the Senate of the United States has ratified it.

The contracting parties have agreed to prohibit their vessels from engaging in pelagic sealing and to close their ports against all vessels connected in any way with the operations of pelagic sealing. It is not necessary in this connection to go into the details of the seventeen articles of the convention, which is to continue in force for a period of fifteen years from December 15, 1911.

The total loss of seals from the North Pacific herds through pelagic sealing since its inception may be placed at about three millions. As a large proportion of this catch consisted of females, the disastrous effect upon the breeding stock of the Pribilof and Commander Islands will be readily appreciated.

The fur seal industry, both at sea and on land, was for many years the subject of almost continuous international controversy, and the Pribilof herd especially has been studied long and carefully by commissions selected chiefly from the ranks of British and American naturalists.

The facts respecting the fur seal's habits, migrations, food, breeding, growth, age, numbers, anatomy, enemies, etc., as arrived at by the commissions appointed to study the subject in general, afloat and ashore, cannot reasonably be questioned. They are based upon prolonged inquiry by representatives of the two countries most interested, and have been mutually accepted only after the keenest possible criticism from both sides.

The natural history of the fur seal is now better understood in detail than that of any other wild mammal. These investigations, commenced about twenty years ago, have yielded much new information, and, with the cessation of pelagic sealing, we are now ready to apply scientific methods to the rehabilitation of the small herd remaining on the Pribilofs with full confidence as to the result.

The polygamous habit of the fur seal is the principal fact with which we have to deal in considering any scheme of management of this animal upon its natural breeding grounds. Each mature male controls from 1 to 100 females, the average number of females in the harem into which the rookeries are divided being about thirty. The surplus of male seals naturally resulting from the polygamous habits of the animal is large, and the most of it has always been available for commercial purposes.

The male seals are thus of two distinct classes: the adults in possession of the breeding grounds, and the immature males located entirely away from such grounds. The latter do not acquire the size and courage to fight their way among the large breeding animals until about seven years old, although otherwise mature at the age of four years.

During the breeding season the mature males are in possession of the harems, where they maintain their positions by sheer fighting ability. Their courage is such that they do not give way even before men armed with heavy clubs and it is dangerous for men to attempt to enter the rookeries at this time. When the males seize each other with their powerful jaws they frequently tear rents in their thick hides. In a quarrel for the possession of a female, the latter may be frightfully lacerated, and is sometimes killed. Fighting may be seen anywhere in the rookeries and many of the very young seals are trampled to death.

The destruction of young through the fighting of the bulls is of serious extent even when large numbers of surplus males are annually killed for marketable skins. It must have been vastly more serious prior to the utilization of sealskins by man.

It is the belief of naturalists who have studied the fur seal on its native islands that the furious fighting of the males upon the breeding grounds actually constituted Nature's check to the unlimited increase of the race. It could have been nothing else, although the worm parasite (*Uncinaria*) of the sand areas must be considered to some extent in this connection.*

Prior to the discovery of the Pribilofs the breeding grounds were undoubtedly overflowed at times by such hordes of mature males that an important proportion of the young of the year, and many adult females, were destroyed.

There can be no doubt that the annual reduction of the male surplus for commercial purposes since the discovery of the islands has greatly lessened the breeding-time turmoil of the rookeries, and that proportionately large numbers of young survive the perils of infancy. Now that pelagic sealing, so wasteful of the adult female life, has been suppressed, we may expect an annual expansion of our shrunken breeding grounds.

The male stock of the islands should be watched with great care and its numbers kept within safe bounds. A sudden increase of fighting males in the rookeries at a time when the stock of females has reached the lowest limit in the history of the islands, would greatly endanger the newly born young.

Here we may take up a matter of importance to this Society. A resolution was introduced in the House of Representatives on August 12 to provide for the suspension of all seal killing on the Pribilofs for a period of fifteen years. This resolution may come up for consideration when Congress convenes. Its passage would be unwise in many ways, but chiefly in the danger of a rapid increase in fighting male seals which it would bring about. While a cessation of land killing for a season or two might cause no serious trouble, the fifteen year period specified is not only too long but positively dangerous, as the Bureau of Fisheries would be powerless to apply the necessary remedy for the evil of overcrowding by males when it becomes serious.

The criticism of the administration of the seal islands which called forth the above resolution of August 12, 1911, was made by men who have not been on the islands for twenty years and who cannot appreciate the recent detailed investigations. Severe criticisms have also been made by men who have not been there at all, and whose opinions upon the subject are of little value.

Plans have been considered for reducing the loss due to the hookworm *Uncinaria*. The breeding grounds of the Pribilofs are located largely upon rocky ground or upon firm soil and have sufficient slope as a rule to prevent the accumulation of sand. There are small patches within the limits of several rookeries which are infested with the parasite *Uncinaria*. This hookworm is responsible for heavy annual losses among the young seals born on sandy areas. The *Uncinaria* parasite was doubtless a greater source of danger in former years than at present. It was, like the fighting of the males, a natural check upon the unlimited expansion of the seal herd, but not so potent. The topography of some of the rookeries is such that an extension of their limits would force the breeding females to occupy unfavorable sandy areas. This source of danger to young seals can be eliminated, if sandy ground is covered with rock, or fenced in so that breeding seals cannot occupy it.

In conclusion it may be stated that with our present knowledge of the life history of the fur seal, there is no reason why our valuable herd should not only rapidly increase in size, but under wise management, actually exceed in numbers the great herds occupying the Pribilof Islands at the time of their discovery.

The principal thing in the management of the rookeries will be, however, the limiting of the number of adult males allowed to enter the rookeries.

Notwithstanding the fact that during recent years a very large proportion of the surplus males has been killed for profit, our annual photographic records show that there has always been, with the exception of one or two seasons, a sufficient surplus of idle males adjacent to each rookery. Such animals force their way in as soon as they acquire the weight and the courage necessary for them to do so. All claims that we have killed too many of the surplus males can easily be disproved by the photographic records of the Bureau of Fisheries.

NOTES ON SOME SELDOM MARKETED SALT-WATER FISHES

By John Treadwell Nichols

Probably in the long run the best food fishes, and those most readily accessible for market purposes, are the ones that it is customary to use as food. On the other hand a casual survey shows many salt water forms which, though eaten in foreign countries, are not utilized in America.

It seems to me that this is a matter which is particularly appropriate for the American Fisheries Society to bear in mind, to the end that the utilization of fishes for food shall be based on a true knowledge of their value, influenced as little as possible by custom and prejudice. I therefore venture to submit a few brief notes, personal experience with fishes which are not regularly marketed.

The mud cat, *Leptocottus armatus*, is a salt water sculpin of small size, very abundant the length of the Pacific Coast. Like all the sculpins it has a large spiny head, and probably more or less on that account is not eaten. At Seaside, Oregon, a Chinaman had cut the heads off a number of them and was taking them home to eat. With the heads gone they looked something like tomcod. He said they were very good. Some small ones about five inches long, from sandy bottom in summer, were fried. They were very sweet and palatable, though their meat was not very firm.

The sea robin, *Prionotus carolinus*, is a very abundant fish in all salt waters near New York. It has a large, hard spiny head and is generally thrown away when caught. A large one about a foot long and a smaller, about eight inches long, were eaten fried. Both were moderately good but the larger had a strong muddy taste, perhaps due to the water where it was taken. The fish is a rather close relative of the European gurnards, some of which are highly prized for the table.

The fresh water silverside, *Menidia beryllina,* is the delicious little fish commonly sold in bulk in the New York market as "whitebait," and eaten head and all, fried. It is very abundant in certain clear, fresh head waters of Moriches Bay, L. I., and is netted extensively for the market. The salt water silverside, *Menidia notata,* resembling it so much in appearance as to be distinguished with difficulty, abounds in the salt and brackish waters adjoining. It grows to a larger size and is edible, but much poorer than the other, as it is less meaty, more bony, and sometimes tastes muddy. It is more difficult to obtain as the schools are not as dense, and the fish in them are less uniform in size.

Two delicious little salt-water fishes which would make as good "white bait" as the fresh water silverside, are the striped and Mitchill's anchovies, *Stolephorus brownii* and *mitchilli.* Both of these occur near New York, though the writer has eaten them only in Florida. He has there eaten the striped anchovy as large as a small smelt, and an unrelated slender fish, the halfbeak, *Hyporamphus unifasciatus,* somewhat larger. The two last mentioned were eaten by several persons and pronounced excellent.

In the winter of 1909-1910, while engaged in collecting fishes for the American Museum of Natural History in Florida, we caught many species in the seine daily, and from time to time would pick out one or two of the best for the table. Notwithstanding its somewhat unprepossessing appearance, the snook, *Centropomus undecimalis,* weighing five or ten pounds, was found to be a food fish of the very first rank. Despite its northern reputation, the sheepshead, *Archosargus probatocephalus,* taken at the same time in the same waters, was pronounced much inferior by several persons; in fact it was rather tough and tasteless and we only ate it once or twice.

The sundial, *Lophopsetta maculata,* common near New York, is a small flounder not utilized for food. It is flat and thin and its flesh is translucent. Nevertheless a young specimen about six inches long, taken this summer from the muddy waters of Moriches Bay, proved to be very sweet and delicious fried. Full grown ones would probably be better. The turbot, which is a large European relative of this species, also has a somewhat translucent flesh.

The U. S. Bureau of Fisheries has recently carefully investigated the food properties of the dogfish and found this a good food fish. My only experience with its giant relative, the shark, is different. A number of years ago, at sea in a sailing ship, from time to time in calm, warm weather, sharks would follow the ship. We caught one of them eight or ten feet long, the species of which unfortunately was not determined. Its flesh was white and beautiful to look upon but decidedly tough and unpalatable. Professor Dean tells me, however, that young sharks are commonly eaten abroad (Italy, Spain, and especially in Japan). In the last named country a blanc-mange-like jelly is made of the meat of sharks and is pronounced delicious by travelers. Shark fins are prized by the Chinese.

The skate (*Raja*) of which there are several species abundant on both our coasts, seems to have been practically unused for food in America until very recently. The New York fish dealers with whom I have spoken are agreed that until three or four years ago very little was sold here. More and more is now being sold, particularly to the Italians. At Blackford's Market (Blackford is perhaps the largest Fulton Market fish dealer) a buyer estimated for me that about 200 pounds of skate a day is now sold in the New York market throughout the year. This comes to about 72,000 pounds a year, and from the statements of other dealers is, I think, a very conservative estimate. Retailers on the upper west side whose trade is of the better class say they seldom handle it; two fish dealers in an Italian quarter on 7th Avenue near 30th Street, sold 50 to 100 pounds a week, one of the fish dealers in the Washington Market claimed to sell 60 pounds a day. Only the pectoral fins, "wings," are used, the trunk and tail being thrown away.

The Washington Market dealer mentioned said that the French people in New York were beginning to buy skate as a delicacy under the name "larae." At Boulogne, France, the writer has seen quantities of it marketed.

DISCUSSION

Dr. Tarleton H. Bean, Albany, N. Y.: I am pretty well acquainted with some of these fish, as we get them in New York waters, and I should be glad to comment on some of them.

The fresh-water silverside, *Menidia beryllina*, I am inclined to think, is erroneously identified, unless the fauna has changed since my collecting experience in Great South Bay. The common species in Great South Bay is the *notata*, with rather heavy, rough scales and broad silvery streak on the side; and it forms a very large portion of the bulk of the so-called whitebait in New York city. The *beryllina* runs up into the fresh or slightly brackish portions of Great South Bay and its adjacent waters, but, as I have said, it is extremely uncommon. You will find it farther south, say in Great Egg Harbor Bay, New Jersey, and there it begins to be abundant, but not in Great South Bay, unless times have changed very recently.

These anchovies mentioned, the *Stolephorus brownii* and *mitchilli* and the third one that has not been named because it is rather rare—the *perfasciatus* of Poey, the common name of which I do not know—are good fish unless they feed on a certain species of algæ, which gives them a stain and a bitter flavor. Otherwise they are the very finest of salt-water fishes. Their flesh is transparent and simply delicious, although they are very small, of course.

I have heard the remark made about the southern sheepshead. Mr. Worth is more familiar with that, undoubtedly, than I am. The southern sheepshead does not appear to be held in esteem as a food, as compared with the northern species. They belong to the same species, but the southern one is smaller and has different feeding grounds and habits perhaps; and it does not have the flavor of the well-known sheepshead of New Jersey and New York.

The spotted flounder, which Mr. Nichols calls sundial, I have heard mentioned as a good food fish. I tried to eat it once and it seemed to me tough and tasteless.

The skates, of course, for many years have been sold in New York; but the work was done so quietly that few people were aware of what they were doing. The wings, or pectoral fins, are delicious.

Another fish well known to most of us, that Mr. Nichols does not name, is the sea lamprey. It runs up in the spring and is eaten in enormous quantities, particularly by the Frenchmen, not only in New York, but in Connecticut and other New England states.

Prof. L. L. Dyche, Pratt, Kan.: It seems to me there are a great many things good to eat that we do not eat because we have not been accustomed to them. Between 40 and 50 years ago Indians were camped near my father's farm in Osage County, Kan.; and I did not think much about Indians being different from other people. We used to go to the Indian camps and I ate about everything that could be put on an Indian bill-of-fare. I ate turtles roasted in the fire, muskrats, and I am not sure but that I ate snakes and many other things I did not know much about. In later years we learned to eat opossum; and if any animal is unfit to eat on account of its promiscuous food habits, we believe it is the opossum; but the "possum" meat tasted pretty good. A few years ago we collected about 50 skins of the large striped skunks; and one day we caught two fine fellows, two-thirds grown. The scent glands are two balls about three-quarters of an inch in diameter. These were carefully removed and there was no more odor about those animals than about an opossum, a raccoon or a small pig, and perhaps not so much. My assistant, Mr. E. D. Eames, and I conceived the idea that they might be baked for Thanksgiving and that we might have a big "possum" feed. We had the banquet, and after the guests ate we told them what the meat was, but we could hardly make them believe it. The meat was tender, juicy and sweet, and with no foreign or suspicious taste. We had eaten the same meat before and knew that it would be good.

On the coast of Greenland I ate a number of things that people are not accustomed to eat. The Danes in south and central Greenland are accustomed to eat whalemeat and especially the skin of the smaller varieties of whales. Eskimos are very fond of it and eat both meat and skin raw. When an Eskimo harpoons a small whale he always gets the tail in addition to his regular portion in the division of the meat. We travelled with these Eskimos and ate what they did. We ate seal meat and shark. I never cared for shark. There is not much flavor to it. But I think if it could be cooked with good Kansas or Missouri bacon to give it a flavor, it would be much improved. Whale skin, when boiled or scalded in hot water, turns white, and it is pretty good when eaten with vinegar or sour dressing. We have eaten the raw skin of the whale while in company with Eskimos. It was a good food, but with no particular taste. A piece as large as your two hands would satisfy an ordinary appetite. It has no bad taste or flavor, and inasmuch as the Eskimo prized it highly we considered that it must be a good food. We ate several things on the Greenland coast, such as seahawks, gulls, shearwaters, guillemots, etc., that people do not often eat. The Newfoundland sailors are more or less superstitious and would not eat a mouthful of bear meat. But they did eat what seemed to be salt horse meat that had been packed in barrels. They would eat that old, strong and tasteless meat in preference to nice, juicy bear steaks cooked in the finest way. I preferred bear steaks to almost any kind of salt meat. I see by the papers that there was an Indian feast here in St. Louis last night where 150 people partook of boiled dog as the chief and almost only thing on the menu. I have eaten dog and I feel somewhat slighted that I was not invited to the feast.

Mr. Meehan: I can sympathize with Professor Dyche as to food in Greenland. I ate some of the narwhal skin in McCormick Bay and found it did not have much of a taste. It is a little difficult to describe. Upon starting it was something like biting India rubber, but your teeth came to with a snap. It had a rather bluish tinge, and was supposed to have a nutty taste, but I did not distinguish it. I attempted on one occasion to eat seal meat that was ripe, killed the winter before, but the odor was much stronger than the flavor of the meat. Being in an experimental frame of mind I tried to eat it.

One of the things I did not attempt to touch, however, was the little creature quite abundant in the hair of the Eskimo, of which they seem to be particularly fond. Quite frequently I have seen them take the little creature as a sort of dessert to their meals.

Professor Dyche: I forgot that.

Mr. Meehan: I remember on one occasion when an Eskimo was remonstrated with for using that dessert he turned around and said he could not see that it was any worse than what the white people did who ate shrimps caught in the water in great abundance and which are known to the Newfoundland sailors as sea lice.

Dr. Bean: I heard an Eskimo explain the habit. When I remonstrated with him for eating the louse, he replied, "He eat me, why me no eat him!"—Reciprocity. (Laughter.)

UTILIZATION OF THE DOGFISH

By G. W. Field

In the first place I ought to say that the species about which I speak is not the dogfish of the middle west, but a species of shark common in various salt waters all over the world and of very general interest on that account. As you know, it is also one of the most abundant of the sharks, just how abundant is not really known; but four or five years ago we attempted to estimate the number by means of statements from upwards of 500 captains sailing out of Boston and Gloucester. We asked them to make a careful estimate of the number of dogfish they caught during the season, and they reported 27,000,000, actually caught on their lines, trawls and nets—27,000,000 dogfish averaging about 7 pounds apiece. In other words, they caught more dogfish than cod, haddock or other fish. They bring into Boston and Gloucester about 200,000,000 pounds of fish annually; and the catch of dogfish alone is practically equal to their entire catch of halibut, cod, haddock and other species combined.

At the same time we attempted to find out approximately how much damage was actually done by dogfish to the nets and trawls of the fishermen. Upon investigation we learned this to be in round numbers about 160,000 pieces of line, etc., with bait attached. As you know, bait in the salt-water fisheries is a very important item, costing 50 cents a barrel and upwards, and fishermen are willing to pay almost any price for the right kind.

But more than that, when the fishermen lifted their trawls, which are often a mile or more in length and have say 2,000 hooks each hanging by a short line every 6 feet, they sometimes found over 1,500 dogfish. On the rest of the 2,000 hooks they found not dogfish, but the heads of codfish and haddock which had been entirely eaten by the dogfish.

When I say the damage by dogfish to bait, nets and trawls is upwards of over $400,000 a year to the Massachusetts fishermen alone, I am well within bounds.

So after all the question of utilizing these dogfish is very important, particularly for the reason that dogfish live almost exclusively upon the edible fish, the young cod and other bottom fish, the lobster, the young of various surface-feeding fishes, mackerel and other species. If we assume that they eat only one or two pounds of fish a day at a cent a pound, and there are at least 27,000,000 doing business all the time, the daily destruction of fish, for which we pay 5 or 10 cents a pound, is very considerable, certainly figuring up a damage of $5,000,000 or $10,000,000 a year at a very conservative estimate. We do not know how much it really costs, but it is certainly going on.

How numerous these sharks are is also shown from the fact that there is a record of an otter-trawl taking over seven tons of dogfish at a single haul. A net about 100 feet across the mouth, dragged on the bottom, brought up at one haul over seven tons of dogfish alone!

Thus the problem of utilizing these dogfish becomes very important. The United States Bureau of Fisheries has done excellent work in urging the utilization of these fish as food. They are prized in other sections of the world as food, but we have not come to that in this country, although, as the Bureau has pointed out, they are as good as many of the fish that are already fashionable.

I believe thoroughly that many tons of these dogfish could be utilized by being dried, ground and used as pig and poultry food, or as food for horses, as they are actually used in Cape Breton. There they are caught and hung on the fences to dry and then used as horse food; about one dogfish a week is given to keep a horse in good condition. Any residue could doubtless be used as fertilizer. Dogfish would constitute a more truly economic source of nitrogenous fertilizer than the menhaden; it is not used as staple food by any other species of economic fishes, as are the menhaden.

So on the one hand we are destroying the alewife and menhaden, upon which many of our fisheries depend for bait, while on the other hand we are leaving in the water the enemy which is destroying countless numbers of our most valuable fishes.

We have therefore made some observations to determine what is the practical value of the dogfish. To put it very briefly, we have found that the oil in the liver is about 50 per cent of the weight of the liver. This oil can be sold for about 25 to 35 cents a gallon, so that one dogfish would ordinarily yield about 2¾ cents worth of oil. In addition to that there is the body, which as a fertilizer is worth $27 to $35 a ton at present. The dogfish then at that rate would be worth about 3 cents for fertilizer, making altogether 5¾ cents. Experiments are still under way to determine whether or not the peritoneum of the dogfish may be used for surgical dressings. I am not prepared to go into that, but it may be an important factor. The peritoneum, you recall, is the delicate covering of the liver, intestines, etc., which can be separated as a very thin, delicate membrane.

Finally, and perhaps most important, we have made some experiments to ascertain the value of the eggs of the dogfish. Each female dogfish yields from four to eight eggs; how often we do not know, but probably two or three times a year. These eggs are retained in the body of the dogfish until they are hatched. The young are born alive. We find that the eggs can be used by tanners as hen's eggs are used. For a practical demonstration we furnished the tanners with about 75 pounds of the eggs, and we received a report that they could be used the same as hen's eggs. You know that in preparing glove leather it is important to get the oil into the leather in such a way that the leather will not remain greasy. For this purpose they make an emulsion of the oil and treat the skin with it. Hen's eggs are used by stirring them up in the oil, and thus used it is found that one dogfish egg is equal to two hen's eggs. In other words, one dogfish egg will emulsify as much oil as will two hen's eggs. The average yield of eggs is 4½ ounces per dogfish, of a value of at least 1 cent per fish. Here is some glove leather prepared in Peabody with the dogfish eggs.* The only difficulty is that the leather is not as white as the leather prepared with hen's eggs, but nevertheless the tanners in Massachusetts are anxious to get the dogfish eggs at a reasonable price.

It was also found that the fins and tail of dogfish are used very largely by the Chinese, and we have had inquiries from Hong Kong as to whether or not we can ship shark fins and tails to Hong Kong and Singapore. They have gone so far as to send us samples which they say are satisfactory, and I judge from the odor that the preparation of dogfish fins and tails would be relatively easy. They are also used in making soups of a gelatinous character. The value of the dried fins and tail, prepared with salt and sugar, is about 20 cents per pound retail, or a value of 5 to 20 cents for each adult dogfish. The total value therefore of oil, fertilizer, eggs and fins is not less than 11¾ cents per fish and may easily double this amount.

The question of the utilization of dogfish depends on the question of bringing them into port. Fishermen refuse to bring them in at present. We are now endeavoring to make a market by which the fishermen can bring the fish to definite places for utilization. But that is difficult, for no manufacturer will equip a plant until assured of a definite supply of dogfish. We asked a fisherman to bring in a few dogfish one day, and he brought in 1,800 pounds instead of 50 pounds; and then for several days we could not get any. So the manufacturers are unwilling, until they can find a definite and regular source of dogfish supply to equip their factories for the purpose. We have suggested that a power vessel might be profitably employed to collect the dogfish from the vessels on the fishing ground, *e. g.*, South Channel, or Georges, and bring them to the factory, or even have

*The speaker exhibited a fine specimen of tanned and prepared sheepskin, though of a slightly yellow tinge.

the vessel equipped with a small rendering plant to operate at sea near the fishing fleet. But we are rather hopeful of a solution from the fact that a fleet of otter-trawlers is developing in Boston harbor. There are at present four, and at least two more will be launched soon. The question is whether these otter-trawlers, which catch a large quantity of dogfish may not find it profitable to bring them in either entire or in part, *e. g.,* livers, eggs, fins and tail. The otter-trawlers are very much opposed by the general fishermen and vessel owners, who believe that they will destroy the fishing grounds, as it is claimed that they have done in the North Sea. If, however, it can be shown that the otter-trawlers can be used for destroying these dogfish and placing them on the market, thus cutting off an enormous economic loss to the fishermen, possibly there will be a better feeling between the old line fishermen and the otter-trawlers.

NOTES ON POND CULTURE IN THE PHILIPPINES

By Lewis Radcliffe

The islands of the Philippine Archipelago lie wholly within the tropics. The land area extends north and south 1,150 miles, east and west 650 miles, and comprises more than 3,000 islands with a soil area of nearly 128,000 square miles, or about one-sixth of the total area. The water on the wide plateau on which the islands stand is relatively shallow, much of it being less than 200 feet deep. Notwithstanding the excellent opportunities afforded the salt water fisherman, pond-culture holds a most unique and important place, ranking in capital invested and output as one of the most important fisheries of the islands.

Pond-cultural operations have been carried on in the region about Manila for at least half a century. The ponds are confined mainly to the lowlands adjacent to lagoons and tidal streams, lands of little or no value for other purposes. The principal region lies around the shores of Manila Bay. Its ponds alone are valued at more than $3,000,000* and it is with the methods used here that the present paper deals. In the province of Bulacan alone, the governor reported in 1908 nearly 15,000 acres devoted to these operations.

The ponds are simple excavations of varying size. Some of the larger cover several acres and are often subdivided, each subdivision having a specific function. Two small ponds near Cavite, 35 by 58 and 30 by 120 feet, united with one another by a sluice and with a neighboring stream by a narrow supply channel, had been built at a cost, including masonry, of less than $50.

The following description of one of the larger ponds near Manila will serve to illustrate this class. It was 600

* An estimate made by Mr. Wm. D. Carpenter, who has given the study of the methods used in the Philippines considerable attention and to whom I am indebted for corroboration of a number of doubtful points and for some additional ones.

by 1,200 feet, with a strong earthen retaining wall and was subdivided as follows: 480 feet from the upper end had been built a low cross-embankment with a sluice gate near one end; 600 feet farther down was a similar wall and gate; the narrow strip at the lower end was subdivided into two unequal ponds, the larger opening into the adjacent large pond and also into the small one, the latter also into the large pond and by an outlet into the neighboring river. The two large ponds serve as the main stock ponds; they may be used in conjunction or separately. The third is used mainly for holding the young fry until they have reached sufficient size to admit of their introduction into the main ponds; the smallest serves as a control and as a place for catching the fish. The water level is controlled by wooden gates fitting into masonry and is normally kept from three to five feet deep. Whenever desired, much of the water is drained off at low tide and the pond refilled by the incoming tide. Screens of closely woven hemp fibre (sinamay), closely woven bamboo mats and the like are used to prevent the fish from escaping.

The ponds require but little care. If they are in need of cleaning the water is drawn off and natives armed with pieces of boards scrape down the soft mud and force it out with the outgoing current into the river.

Attempts at artificial propagation of fishes have proved unsuccessful; instead the ponds are stocked each year with young fish taken from the sea. The milkfish, *Chanos chanos* (Forskål), possesses to an exceptional degree the characteristics needed in artificial cultural methods and is practically the only species planted. Many others (mullets, gobies, eels, species of *Ambassis*, *Elops*, *Megalops*, etc., and a shrimp) find their way into the ponds and add to the total output.

The milkfish is a pelagic form. It spawns in the shallow water near sandy beaches. From April to August, the young may be caught in the surf near these localities. They are most abundant in May. A strip of coarsely woven hemp fibre made into a square scoopnet or a rectangular piece of the same material used as a seine serve to catch the fish. The fishermen wade parallel with the beach, dragging the net near the surface and straining out the young fry. These are placed in earthenware vessels holding five or six quarts, two or three thousand fry in each.

The catch is transported with all possible haste to the ponds and disposed of at varying prices depending upon local conditions, size and abundance of fish, distance from fishing grounds, weather conditions, etc. The number of fish in each vessel is estimated by holding one valve of a clam shell or a small white earthenware dish below the surface of the water. Against the white surface the larval fish become visible and the number swimming above it noted. If buyer and seller fail to agree, the laborious process of counting at least a part of the catch is resorted to. For recording the count small pebbles or the shells of a small univalve, divided into lots of a hundred each are used. The fish are immediately planted in the smaller ponds.

The following records of fry planted indicate roughly the number of fish the ponds are capable of supporting. In one pond 60 by 120 feet, 600 fry were planted; in two ponds 35 by 58 and 30 by 120 feet, 1,500, and in a series covering about six acres 150,000 fry were planted annually. When the ponds are to serve as temporary retainers five to six times this number may be planted. Some of the owners of small ponds use them for this purpose alone, purchasing their stock for from $1 to $3 per thousand and selling later at $10 to $40 per thousand.

As the fish kept in this manner are largely dependent upon the tide for food, their growth is often considerably retarded. With an abundance of food in ponds not overstocked, their growth is exceedingly rapid. Thus a fish 3/5 of an inch long planted in April, may reach a length of a foot by August, 16 inches by November and 18 inches the following March. The fish feed upon one of the algæ (*Œdigonium*). This grows best in shallow pools of still water. To encourage its growth in the ponds they are drained and refilled as fast as the growth of the algæ permits.

After remaining in the small ponds for about eight weeks, the young fish are introduced into one of the larger ponds. Under the new conditions they grow very rapidly. As soon as the *Œdigonium* becomes scarce the fish are admitted to another pond, the former is then drained and the rapid growth of a new crop of algæ encouraged. When the fish are about five months old, the owner may begin harvesting his crop, selling to keep his ponds from becoming overstocked, or according to the demands of the market or his own financial needs. During the Lenten season the fish are in greatest demand and bring the best prices. At this time the balance of the stock is usually sold, preparatory to restocking.

Several methods of capturing the fish are in vogue; the water may be drained off and the deeper pools fished, or, the water level having been lowered and the tide outside arisen, the gates may be opened, setting up a strong current into the ponds, when the fish swimming against the current enter the small control pond from which they are easily taken. To satisfy a certain demand from those who wish to eat the entire fish, eight to twelve hours before making the catch the fishermen wade about in the ponds, beating the water to frighten the fish as much as possible. This causes them to cease eating until after the catch for market has been made, the stomach then being comparatively empty.

About nine-tenths of the people of the islands use fish as their principal flesh diet. Practically all fishes over an inch in length, and not considered actually poisonous, are eaten. Whenever there are storms or typhoons, many of the salt water fishermen are unable to operate their nets, fish their traps or send the catch to market; at such times the market is almost entirely dependent upon the catch from the ponds.

The milkfish is a bright, silvery, wholesome looking fish whose flesh is relished by native and foreigner. Its growth is very rapid under the artificial conditions in the ponds. These factors combine to give the cultivation of pond fishes a very important and profitable place in the fishery industries of the islands. With greater co-operation among pond owners against losses from flooding; with better methods of securing, transporting, and caring for the fry; with more scientific knowledge as to the habits and care of the species under cultivation; and with improved marketing facilities, this industry may be made to outrank any of the island fisheries.

THE TAXATION OF OYSTER PROPERTIES

By Henry C. Rowe

The subject of the taxation of oyster properties has recently received much attention from legislators, state officials and other persons more or less acquainted with the oyster industry. It has been under consideration in several states, and doubtless will be in others soon. In Connecticut the General Assembly has had before it over twenty bills affecting oyster matters during the past eight months, and there have been extensive hearings and discussions. Prior to that, for two years the subject was under investigation by a commission. In this discussion many propositions have been urged and answered, and the disproved assertions and superficial opinions have been discredited and rejected. In this paper I shall briefly state the results. The facts can be easily verified, and I hope that the deductions will be obvious.

The oyster growers in Connecticut, and so far as I know, elsewhere, make no objection to paying their just share toward the expense of government as other citizens pay upon other classes of property. How then shall this share be ascertained and fixed? The decision has been reached that where perpetual franchises have been granted to individuals for the propagation and culture of oysters, it is reasonable that these franchises should be assessed at their fair market valuation, and should pay such a rate of percentage of taxation as is proportionate to the protection of law which they receive.

The tax commissioner of Connecticut, after investigation, recommended that all cultivated oyster grounds should be assessed at an equal or flat valuation, and asserted that the clerk of shell fisheries, whose duty it has been to make these assessments, is not competent to assess them at adequate valuations. A practical oyster grower was, however, called upon to make these assessments, and according to the report of the tax commissioner, this oyster grower increased the assessments on the average about 250 per cent, so that the tax paid to the state, since that assessment, was increased from $11,000 per year to $26,000. It was thus shown that one who is qualified to do so, could adequately assess the ground, in fact, some of the grounds were greatly overvalued in this instance. The Connecticut Legislature decided that it would be grossly unfair and inequitable to assess the grounds owned by A at the same valuation per acre as those of B, when in fact B's ground was worth one hundred times as much as A's.

As to the rate of taxation, it has been, in Connecticut, since 1893, one and a half per cent of fifteen mills on a dollar of valuation. A proposition was made to increase this rate to 17½ mills, but the General Assembly rejected this proposition, because 17½ mills on the dollar is as much as the taxation in many cities and boroughs, which in those cases pays for fire protection, street lighting, police, schools, sanitary regulations, and many other benefits which are not, and could not be extended to oyster grounds. For instance, it is clear that oyster ground covered by 20 to 40 feet of water is in no need of fire protection, street lighting or paving; but there is no other property which is so exposed to depredation, because oyster grounds are situated under navigable waters which are a public highway for every kind of vessel and boat by day and by night; also these oyster beds are usually situated remote from protection, except such as is especially provided.

In the case of those states where the ownership of the oyster grounds is retained by the state and they are leased to propagators and planters of oysters, it would, of course, be unreasonable to lay any tax upon the grounds which in fact are owned by the state, and for which the planters pay whatever rental is established by the state before their leases are taken. The owner and landlord should pay the taxes, and not the tenant.

There are some minor considerations which have been urged with reference to the preceding questions, but when adequately answered the result remains the same, hence I will not in this paper take them up in detail.

There remains another question which has been raised occasionally during the past thirty years, but which has always been answered in the same way. In Connecticut there has recently been a very extensive discussion and contest over this question; whether oysters propagated, planted and grown upon the private cultivated grounds should be taxed. On public beds, where the state owns the grounds and the oysters grow naturally without artificial propagation and cultivation, it would seem to be optional with the legislature whether the state should derive a large or small income from the natural product of these grounds. This is done in some instances by charging a license fee to those who derive the benefit of catching the oysters and shellfish upon these grounds. The rights of all citizens of the state are equal in these shellfish, but it is obvious that it would not be practicable for all the citizens of the state to share in the products of these grounds, when special equipment is necessary in order to take the oysters, in some cases costing from $500 to $2,000 to each vessel used for the purpose.

In order then that all the citizens of the state should partake equally in the benefit of these grounds, it has been shown by those officials who have made this subject a study that either these grounds should be sold or leased to individuals, or else that those who have the exclusive privilege of working upon these grounds, by reason of equipment, etc., should pay for suitable licenses to produce a reasonable revenue to the state for the privilege which they enjoy.

The question as concerns oysters artificially propagated and grown upon the private oyster grounds, which are owned by individuals practically in the same way that real estate is owned on land, is an entirely different question, and is analagous to the crops of corn, wheat or cotton, or other crops which are grown upon the land. It is not considered public policy to tax the growing crops of the farmer, and there is no reason why any different rule should be applied to the crops which are grown upon oyster grounds. There is perhaps even some additional reason why oyster crops should not be taxed. They are exceedingly hazardous, and no oyster planter knows whether he will secure a crop, half a crop, or less than half a crop until after his oysters are harvested. Oysters are subject to partial or total loss from the effect of great storms, from the ravages of the drill, from destruction by starfish, from being stolen by reason of their exposed situation, and by other causes. There are few crops, if any, on land which are subject to so great hazard as are oysters. Moreover, they are from their situation very poorly protected by lawful authority. Therefore, it would be unjust to discriminate against oysters as compared with other crops for the purpose of taxation.

It is not public policy to lay a tax upon the product of the manufactory or of the farm on land, nor of the oysters produced on the oyster farm under water. It has been one of the principles which has prevailed in our revenue-producing legislation for a long period that taxes should be laid in such a way as to protect and foster our industries, but whether this be well founded or not, it is obvious that it is not public policy to reverse the principle by taxing growing crops, thus penalizing industry and enterprise. This question has just been considered at great length by the Connecticut General Assembly, and has been so decided.

There is another consideration which ought to be mentioned, namely, that the United States Government, and many of the states, propagate swimming fish and furnish them without charge to the fishermen who make a business or sport of catching them. This privilege the fishermen enjoy, in most cases without expense to them, and it would be unreasonable to penalize by taxes the oyster grower, who by great expense propagates oysters upon grounds which he has bought or leased from the state, on terms made by the state itself, while at the same time the United States and the states are furnishing without cost the swimming fish for the angler. In many countries a bonus is paid by the government to encourage fishing on the high seas, although the fishermen in such cases contributes nothing toward the propagation of the fishes.

The growers of oysters throughout the United States pay the same taxes upon their steamers, vessels and boats, upon their docks, packing houses and all their equipment, as any other citizens do upon their property. They also pay taxes upon their product just as soon as it is marketed, in one form or another. The proceeds of their crop is immediately used in their business, in wages, for equipment, or in investments for land, steamers, real estate, or in some other form, and this at once becomes subject to taxation the same as other property through the regular channels and methods. While the oyster crop is growing it ought not to be taxed, unless growing crops on land are taxed, but as soon as it is marketed, it is subject to taxation, the same as any other property.

Desiring that this paper should not become too long, I must not diverge into the minor branches of this subject, but would repeat that oyster growers pay cheerfully all the taxes which are reasonable and equitable, but protest against the application to their industry of exorbitant and unusual methods of taxation, which have not been, and will not be imposed upon other industries which are more strongly represented in the legislative bodies, and are consequently able to protect themselves against injustice.

REGARDING FISHWAYS AND DAMS

By L. L. Dyche

Section 23 of the Kansas fish and game law (chapter 198, Laws of 1911) provides that "no dam or other obstruction across any river, stream or other waters in this state shall be erected or maintained which is not provided with a proper chute or fish ladder of suitable capacity and facilities to afford a free passage for fish up and down the same while the water is running over such dam or obstruction; such chutes or fish ladders shall be of such construction and material as shall be prescribed by the state fish and game warden, and shall be completed and placed in all dams in existence at the date of the passage of this act on or before the 1st day of November, 1911, and all dams built after the passage of this act shall be constructed with such chutes or fish ladders at the time of building of said dams."

A recommended design for such fish ladder as is contemplated in the fish and game law is shown in detail on the accompanying drawing. In addition, the following suggestions are made regarding the construction and maintenance of this form of fishway.

The ladder is to be placed in the principal channel of the stream or where the deepest water is to be found. Especially the bottom of the ladder must be in some permanent pool of the main channel.

As shown in the drawing, a channel or notch must be cut across the crest of the dam sufficient to receive the full depth of the ladder. In the case of masonry or concrete dams, anchor the ladder substantially to the dam crest by means of strap irons and anchor bolts. In the case of a timber dam, cut out a recess for the fishway the same as for a masonry dam, and fasten the strap irons to the principal timbers of the dam crest by means of bolts or long lag screws.

Build the ladder of sound and durable two-inch planking, of as long lengths as it is possible to use, and of the widths shown on the drawing. Make all longitudinal joints over the steps or baffles of the ladder. Bolt together thoroughly at the junction of the horizontal part of the ladder with the inclined part. This junction should be reinforced with wide iron plates as shown, as this is the weakest place in the structure. Use plenty of spikes throughout the entire construction.

The drawing shows the inclined part of the ladder supported and held in position by a framework loaded with rock. A better means of support would be masonry piers in case the bed of the stream is rock or ledge, or pile trestle bents in case the stream bed is soft. Whatever the method used, the supports should be of such a character and should be near enough together to securely hold the ladder in place against the uplifting force of the water during floods.

The upper and lower ends of the fishway must be kept clear of all mud and drift and other debris, and open to the passage of fish. In case sticks or stones are washed into the fishway and become lodged in the pockets of the baffles, these should be removed by hand through the openings between the cover planks.

The cost of the structure will depend, of course, on the height and character of the dam and other local conditions. No general estimates can be made, but the following bill of materials required in the case of a masonry or concrete dam five feet wide on the crest and with a difference of eight feet between the water level above and below the dam, may be given as an example. In this it is assumed that the pool below the dam is four feet deep and that three supports like that shown in the drawing are required:

For fishway:

438 lineal feet of 2 in. by 12 in. planking.
225 lineal feet of 2 in. by 10 in. planking.
2 bent iron plates 16 in. by 3/8 in. by 5 ft.
2 iron straps 3 in. by 1/2 in. by 7 ft.
8 anchor bolts 3/4 in. by 12 in.
40 bolts 3/8 in. by 3 in. Spikes as needed.

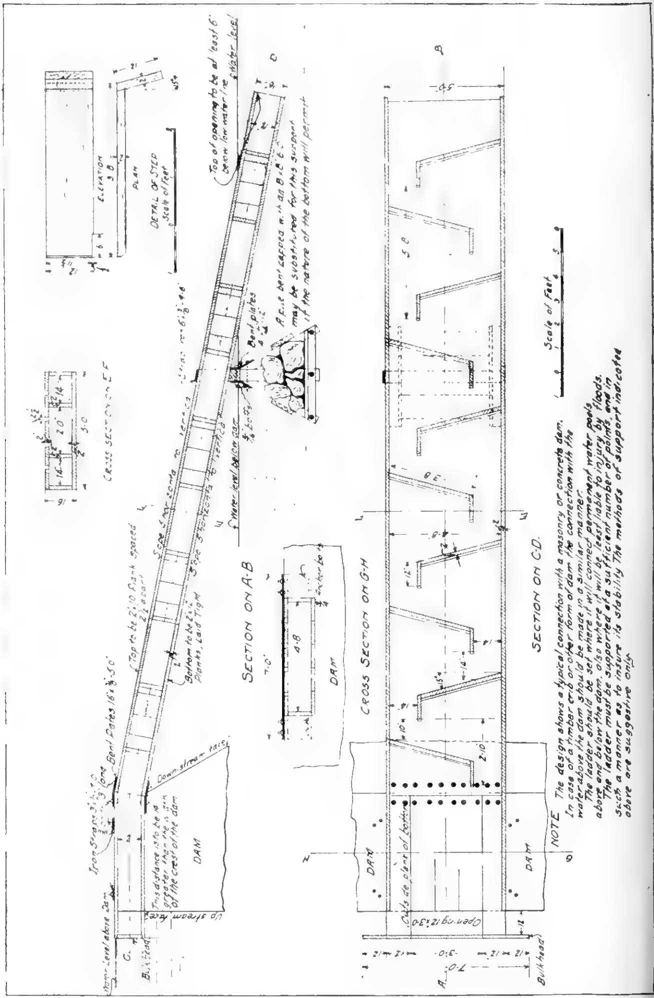
For frame supports:

90 lineal feet of 2 in. by 12 in. planking.
18 lineal feet of 2 in. by 10 in. planking.
60 lineal feet of 6 in. by 6 in. timbers.
68 lineal feet of 4 in. by 4 in. scantling.
12 bent iron plates 4 in. by ¼ in. by 12 in.
3 iron straps 6 in. by ⅜ in. by 9 ft. 6 in.
6 bolts 5/16 in. by 11 in.
6 bolts 5/16 in. by 16 in.
18 bolts 5/16 in. by 9 in.
Spikes as needed.
Rock for piling in and around supports.

Estimated cost of material for the above structure:

Lumber	$52.00
Iron work and bolts	35.00
Spikes	12.00
Total	$99.00

This fishway may have as many twists and turns as a stairway, and may be built anywhere over the dam where the depth of the water would be sufficient. It may even be built around one of the end abutments. The slope of one foot to five must, however, be preserved. In practice, some of these fishways have been constructed of cement, others of steel, and others of a combination of these materials.


DETAIL OF STEP
ELEVATION
PLAN
CROSS SECTION ON E-F
SECTION ON A-B
CROSS SECTION ON G-H
SECTION ON C-D
DAM
Scale of Feet
NOTE The design shows a typical connection with a masonry or concrete dam. In case of a timber crib or other form of dam the connection with the water above the dam should be made in a similar manner.
The ladder should be set where it will connect permanent water pools above and below the dam, also where it will be least liable to injury by floods.
The ladder must be supported at a sufficient number of points, and in such a manner as to insure its stability. The methods of support indicated above are suggestive only.

DISCUSSION

Mr. G. H. Graham, Springfield, Mass.: I am very much interested in fishways, and I would like to ask Mr. Meehan or Professor Dyche, or anybody else, if there are any fishways which will permit of the fish going up, and in that respect are they a success?

Mr. Meehan: I can speak of the matter so far as a fishway that is in operation by the state of Pennsylvania is concerned. It is a fishway designed in the first place, I believe, by some one connected with the Bureau of Fisheries, at Washington, and adopted by the United States Government, also adopted by Pennsylvania; a device known as the Cail fishway. It has been very effective in the waters of Pennsylvania. Last summer, while inspecting one of these fishways, I drew the water off. This fishway was 300 feet in length, and the character of the dam was such that it was impracticable to follow the specifications exactly in its construction. This dam was one of the largest in the world, 60 feet high and about 50 feet thick at the base. The consequence was that the outlet of the fishway had to be something like 200 feet away from the toe of the dam in order that it might be submerged at low water. It was a double fishway, too, and with double width to every compartment. From the bottom to the top it was simply packed with eels, thousands upon thousands of them. There were also thousands of yearling and larger sized sunfish. Several bass were found in the compartments and one or two pike-perch, showing that the fish would go up those fishways.

The same fishway was placed in a large trout stream in Tioga County, where the dam prevented the fish that had gone down in the spring from going up above again along about September. The pool below the dam prior to the erection of the fishway was always packed with trout and very few large trout were ever caught in the water immediately above the dam. But after the building of the fishway many large trout were caught, and trout were seen, according to reports to the office, going through the fishway.

We found, however, that shad would not go through such fishways unless they were very low. In one dam on the Susquehanna River at Clarks Ferry, we had four of those fishways and, prior to that time no traces of shad were found above the dam; but the following year some dead spent shad were found in the west branch of the Susquehanna near Williamsport. Also in some nets that we found on the north branch of the Susquehanna about 50 miles above there were a number of young shad. But we must say that our experience with fishways and shad has been rather disappointing. Shad apparently are afraid to go through them.

The fishway itself consists of a series of compartments or boxes; the bulkheads forming the compartments are provided with openings on alternate sides, and only of sufficient size so as to cause some of the water to flow over the bulkheads, thus allowing the fish to either pass through said openings or over the top of the bulkheads. So far as the fish other than shad are concerned they have been successful in Pennsylvania.

Mr. Graham: I referred especially to shad. There is a great field for some inventive mind, because no one has as yet invented a means whereby the shad will go up.

Mr. Meehan: During the last few months of my tenure of office I was bitterly criticised for putting in a fishway at this dam 60 feet high, which was "utterly useless because the shad would not go through." Possibly it might be interesting to know that on the York County side of the dam—the right bank of the Susquehanna—is a pile of rocks that reaches within 10 feet of the crest of the dam. We noticed last spring that there were two or three pools in the river formed by a series of rocks, and a number of shad succeeded in getting to the topmost pools, or within 10 feet of the crest of the dam. I got in communication with the company owning and controlling this big dam (McCall's dam); and when I went out of office they were preparing plans for an artificial series of rock pools to be made clear to the crest of the dam; so that the shad could reach one pool from the other. We had hopes it would be effective in letting some shad at least go up into the river above. There was a fair prospect of it at any rate, from what we had seen.

Secretary Bower: Just a word anent the Cail fishway, of which mention was made. After many years of experimentation and investigation, the Bureau of Fisheries has adopted what is known as the Improved Cail Fishway. The original Cail fishway has been modified by Mr. Hector von Bayer, the architect and engineer of the Bureau of Fisheries. Whenever he receives any communications on the subject the interested persons are referred to this particular form. It is described in a pamphlet issued by the Bureau about two years ago. Drawings, blue prints and directions are furnished on application.

Mr. W. O. Buck, Neosho, Mo.: There is a fishway on the Penobscot at Bangor designed by Mr. Atkins, which he told me was examined at one time by himself and the state commissioners and found to contain salmon in every pool. It is intended especially for salmon and consists of a double spiral of pools on the plan of the Cail fishway. He considerd it a success for salmon.

At the head of a branch of the Penobscot in the town of Orland there was a small fishway to enable alewives to pass a dam some twelve feet high, arranged on somewhat the same principle, that is, in pools; being a narrow sluice divided by transverse partitions having openings on alternate sides of the sluice by which the water fell from one pool to the next. Both of these I understand to be of the Cail fishway pattern.

Mr. Atkins' article on fishways published in one of the earlier reports of the U. S. Fish Commission—I think that for 1878—was a very complete summary of all the fishways in use at that time. The article would be a valuable reference in studying different styles of fishways.

DISCUSSION OF FISH-CULTURAL CONDITIONS AT FOREST PARK, ST. LOUIS, WITH SPECIAL REFERENCE TO THE PROPAGATION OF BLACK BASS

Mr. S. G. Worth, Mammoth Spring, Ark.: Mr. President, if I am in order, I would like to make an allusion or two to the visit of members of this Society yesterday at Forest Park. I wish to say that I found great pleasure in the visit, and I learned something. I was really surprised to see so large a number of fish, and it is a confession, not to my discredit I hope, although I am in the same line of business for the Bureau of Fisheries at Mammoth Spring, to admit that if this Society had visited that station yesterday in place of Forest Park, it would not have seen such a display. I believe in the motto of giving credit where credit is due, and I wish to say emphatically that I was delighted and surprised at the great quantity of fish seen.

These fish had an extraordinary amount of shore line, and in my short experience with the black bass, I had already come to the conclusion that to make black bass culture a success, that is, in rearing the fish from fry up to fingerlings of 2, 3 and 4 inches size, that which is needed—an element that is essential—is a quantity or great amount of shore line. The young appear to feed right around the shores, and at Forest Park there seemed to be a very large percentage of shore line in comparison with the pond area. I am referring now to the ability of the young fish to find their food. They feed in the shallow water.

When I made similar remarks yesterday at the park, some gentleman at my elbow said, "And it gives a tremendously increased spawning area." So that there would seem to be an additional advantage.

The presence of goldfish in the pond struck me as being a valuable thing. My observation of the goldfish at the Mammoth Spring station is that they are propagating all through the summer and in great numbers. I believe that the bass at Forest Park are in such nice condition and are so numerous, because they have quite an amount of food derived from the young goldfish. It is very evident there is a large food supply. I cannot guess what it is, but I think unquestionably that the goldfish contribute largely to it. I believe it to be a good plan to put goldfish in the rearing ponds to produce food for the young bass.

Mr. W. O. Buck, Neosho, Mo.: Let me add a word for the purpose of getting on record something of what we saw at the fish pond in the park,—and I wish much more in regard to it could be put in our records.

Our conductor told us that the brood fish were put into the pond absolutely in pairs. Now those of us who have handled bass know that in that case they must have been put in very shortly before their spawning period, because it is practically impossible to distinguish the sexes much earlier. Then he said that they were removed from the pond immediately after spawning, about May 15, and further that the young fish were immediately assorted as to size, also as soon as they became large enough they were assorted twice a week.

These four points will be of importance to every one interested in bass culture, and the only way to get them before those who are not present is to put something in our record, which is my excuse for drawing attention to them now.

Mr. Meehan: Gentlemen, this matter of bass culture is one of very great importance, and, curiously enough, there have been no papers presented at this meeting on that subject—the first time in many years within my knowledge—and I am especially glad this matter has been brought up now, because I think it is important that we should have something to say about bass culture, large and small-mouth bass culture or both.

One thing in the utterances of the first speaker about the condition of things in the pond yesterday, I would not have missed for anything. The fish were in splendid condition; they could not have been in finer condition; I never saw finer fish for their age. I feel, therefore, that we should go into this matter and have further discussion on the whole question of the bass. Dr. Bean, I think you can perhaps tell us something of very great interest in regard to this matter of bass.

Mr. Worth: If Dr. Bean will give me a moment I want to say that in my remarks I mentioned Forest Park, but not the Missouri State Fish Commission or the gentlemen who have had the honor to do that excellent work out there. I think that in the proceedings that point ought to be mentioned. I do not know the names of those gentlemen, but I suppose the work is being done by the Missouri State Fish Commission.

Mr. Meehan: That is right, the Missouri State Fish Commission.

Dr. Tarleton H. Bean, Albany, N. Y.: Mr. President, I do not know how many of the state commissions would be able to profit by the experience of New York, but I think it ought to be a matter of record that in our state we take advantage of the spawning season of the alewife, which we get in the Hudson River during the shad season. The alewife is so accommodating that it arrives at our hatching station at just the right time, and continues to grow in just the right ratio of progression to bring our bass to the same condition in which these splendid bass in Forest Park were found yesterday. Without intending to boast, I think that New York has as fine small-mouth bass as any other state, and it is due to the opportunity to get alewife eggs at the proper time.

Then Nature has done something else for us in New York which I presume she is also doing in other localities. We have the black fly which on entering the larval stage collects on the slash-boards of our pond outlets in such enormous quantities that the little bass generally gorge themselves, so that one can almost see them grow. I have really been astonished coming down to that bass station week after week to note the rapid strides that the bass were making.

With the alewife and the black fly larva we do not have to feed our bass anything. Nature does it for us, and still we have the most beautiful bass—they are as fine as the bass in Forest Lake—and we feel very happy over it. I believe that any state having access to alewife fisheries can undoubtedly utilize the alewife eggs in that way.

We also propagate shad at that same station. We take about 8,000,000 shad eggs at Rhine Cliff, which is some 20 miles below the point at which they were taken in the time of Seth Green, 35 or 40 years ago; but still we take them and we are getting almost as many every spring as were collected at Castleton 40 years ago. Of course we hatch those eggs, and in getting them we obtain also alewife eggs. We get from 50,000,000 to 100,000,000 during the season, giving us an ample supply for our ponds.

Then we rear some shad. The shad appear to find in these ponds daphnia, cyclops and other little crustacea in enormous quantities. Our ponds are not large, but are well arranged, have both shallow and deep areas, with plenty of aquatic plants; so that the insect and crustacean life is attracted to the ponds, and the fish get the benefit. The shad grew this year to a length of 6 inches up to the time when they were liberated; and they were fed only on cracker dust, just as the Connecticut Commission used to do. We planted about 100,000 at one time from 3 to 6 inches in length.

Mr. Worth: I would like to ask Dr. Bean what the scientific name of that black fly is, so that we can look it up.

Dr. Bean: It is a species of *Simulium*. I have the specific name, but I do not remember it offhand. It is one of the black flies. The little bass are so fond of this larva that they will actually swim all over the hand of the attendant feeding them. They lose their fear, although the young bass is a pretty shy fish; they come and seize deliberately, without fear, every larva that can be taken off the attendant's hand.

Mr. Meehan: What is your method of breeding this larva?

Dr. Bean: We do not have to do that at all. It comes into the ponds every year. The only thing that we add to the pond is the alewife fry.

Mr. Meehan: Are the eggs deposited on the edge of the ponds?

Dr. Bean: Yes.

Mr. Meehan: And then as they hatch the larva falls into the water?

Dr. Bean: Yes; and they collect on the slash-boards of the pond outlets. The attendant simply goes there, and with his hand or a dipper takes out a handful at one movement; they are then given to the bass in the usual way.

Mr. Meehan: If it became necessary or desirable to introduce this fly for such purposes, would its culture be difficult, or haven't you looked into that feature?

Dr. Bean: No, I have not. We have not had occasion to introduce it, because it is always there. The same thing is true at Constantia.

where we rear the most of our black bass. We have there practically the same species of black fly. The men thought they were worms at first, but the bass knew what they were and what to do with them.

MR. MEEHAN: Is the fly itself a nuisance?

DR. BEAN: Not at all.

DR. S. A. FORBES, Urbana, Ill.: I can answer some of the question asked concerning *Simulium* or black fly. We have, in fact, been making special studies of this insect along the Illinois River during the last two years, taking the subject up at the request of the Pellagra Commission of the State of Illinois because the black fly has been suspected by physicians of being concerned in the conveyance of pellagra from person to person.

Black flies are common all over the country wherever conditions are fit for their multiplication. They must have running water with a considerable current, and will not breed in stagnant or sluggish water. We find the larvæ, for example, in the larger rivers of the Mississippi system only where there is something to arrest the current and create a ripple over an obstruction. Where a mass of drift-wood becomes packed together in a way to check the movement of the stream, the surface of this submerged wood will often become black with these larvæ, which hatch there by myriads, and can perhaps be found nowhere else in the stream. The adults thus become an enormous nuisance, the fly itself being a pestiferous creature, as violent as a bee and as persistent as a mosquito.

You will see, consequently, that if you want to get black fly larvæ to feed to young black bass, you must have some such conditions as I have described; that is, shallow water with a freely flowing current in which the larvæ can live. They apparently require a certain degree of æration of the water which they do not get in stagnant situations.

MR. MEEHAN: Does the black fly actually convey the pellagra disease? That would be rather interesting to fishermen, because if it did there might be some hesitation about introducing it.

DR. FORBES: Perhaps I ought not to have mentioned that matter, because it is a point still under discussion by physicians in this country. Most of those who have investigated it seem highly skeptical of the theory that the *Simulium* gnats are agents in the transmission of pellagra. That idea sprang up in Italy, where one of the great authorities on insects as carriers of disease, Dr. Sanbon, of London, was investigating the cause of pellagra. He came to the provisional conclusion that in Italy the black fly conveyed the disease; and our people in this country then took the subject up. We have worked with it for two years in Illinois, particularly in neighborhoods where pellagra has shown up as a local disease, and we have failed to find any evidence that the black fly has anything to do with it.

DR. BEAN: I suppose there are a great many species of *Simulium?*

DR. FORBES: Yes.

DR. BEAN: I am quite sure there is no pellagra in Columbia County, New York, and never has been, nor in the Adirondacks where other species of *Simulium* occur; but whatever the cause may be, the *Simulium* in Columbia County is not troublesome, but a boon to the fish culturist.

Mr. Buck: I would like to ask Dr. Bean to go a little more into detail in regard to the handling of alewife eggs. I do not have it quite in my mind whether he attempts to hold the young fish after hatching the eggs or not.

Dr. Bean: The alewife eggs are hatched in the McDonald jar or other good type of jar, where you can get a circulation of water. It is a very easy thing to do. They hatch in a few days and begin to grow. Our ponds appear to be full of the natural food which the herring family like. We may be more fortunate than others, but I doubt it very much. I believe that any state in which the alewife occurs may take advantage of the very same thing.

Mr. Buck: You put them into ponds soon after they are hatched?

Dr. Bean: Yes, we put them in the ponds as fry soon after they are hatched. Of course the alewife is very small.

Mr. Worth: I find this talk about the black fly very interesting, and would like to ask if it is the same as the buffalo gnat?

Dr. Forbes: It is the same thing. They are different names for the same insect.

Mr. Worth: I wish to refer again to the large-mouth bass pond at Forest Park that we visited yesterday. A description of the nature of the pond I would like to have go into the record. One of the gentlemen present who is connected with this work said that during this summer they worked heroically to get the water moss out of the pond. Meanwhile he had gotten out of goldfish, but by some arrangement he secured adult goldfish from the Park Commission here and put them in, and he said that in a few days the water moss was gone—eaten by the goldfish. At the Mammoth Spring station last summer we spent considerable money to get the moss out; otherwise we would have gotten no young bass. It would appear from what he said that the goldfish pastured on the moss and destroyed it.

Mr. Meehan: Was it chara moss that was in the ponds, or did you ascertain what it was?

Mr. Worth: I did not ascertain what kind it was.

Mr. Meehan: The assumption would be that it was the chara moss.

Dr. Bean: No, it is one of the milfoils.

Mr. Meehan: The goldfish could get away with that, but it is hard to understand how they could get away with the chara.

Dr. S. P. Bartlett, Quincy, Ill.: I desire to say that the superintendent of the Missouri Fish Commission is here, and he will be very glad to answer any questions. I have watched those ponds carefully for a number of years, and I want to say that I do not believe there is anywhere in the United States a state commission that has produced the same number of bass for the same amount of money, as has resulted from the work of the Missouri Fish Commission. Added to that I must mention the intelligent work of the President, Mr. Geserich, who has given it a splendid business administration, something Missouri has not had for a good many years. The output has been simply fabulous. Mr. Kopplin, the superintendent, will be glad to answer any questions as to the management, food, etc.

Mr. Meehan: I want to say that about a year ago the superintendent of one of the stations in Pennsylvania told me that he had found a very cheap and effective method of getting rid of algæ in his ponds, something we were being bothered with a great deal. He did it by placing white and yellow catfish in the pond, especially the young—the advanced fry and fingerlings—and it was remarkable the speed with which they cleaned up the algæ in those ponds. They caught them by the hundred and were very effective in doing it.

Prof. L. L. Dyche, Pratt, Kan.: I would like to get some idea about the number of fish produced per acre. In our hatchery in Kansas for two years we have at considerable trouble counted the fish, and I would like to know what is considered a good crop of fish per acre.

Mr. Worth: I would like to ask one question: I would like to know what the algæ is that has been spoken of, whether it is that floating, long, veil-like, green substance on the surface of the water, or whether it is the growing plant with roots down underneath the surface of the water.

Mr. Meehan: We should be very glad to have Mr. Kopplin's experience in these matters.

Mr. Phil Kopplin, St. Louis, Mo.: It is a green floating algæ, with the long stems. I believe the goldfish rooting along the bottom cause it to die. It is a short-lived plant anyway.

Mr. Meehan: It is said here that you have placed in that pond 415 bass.

Mr. Kopplin: Yes.

Mr. Meehan: And they were exactly in pairs?

Mr. Kopplin: Yes.

Mr. Meehan: Put there last fall?

Mr. Kopplin: This spring, just before the spawning time.

Mr. Meehan: I was going to ask how you distinguish the sexes?

Mr. Kopplin: I usually wait till just before spawning time, and it is easy then for the fishman to determine the sex.

Mr. Meehan: The matter was spoken of here some time ago. One of the members spoke about it and understood that these fish were put in last fall and we were all interested to know how the sexes could be differentiated.

Professor Dyche: In how many acres of water were the 450?

Mr. Kopplin: Four and one-half acres.

Mr. Meehan: Have you tested them as to whether that is the capacity of the pond for those fish or not?

MR. KOPPLIN: No, I have not.

MR. MEEHAN: What was your output last year?

MR. KOPPLIN: 70,000 to 80,000 fish, but a good many of them were distributed in the fry form.

MR. MEEHAN: Let me understand your expression of the word fry. What do you mean by that?

MR. KOPPLIN: The fry are those little fellows.

MR. MEEHAN: Less than an inch long where the sac is gone—advanced fry?

MR. KOPPLIN: Yes, about an inch long. Those fish out there were hatched about the middle of May, and by the 27th of the month you would find fish there an inch long.

MR. MEEHAN: Was that 80,000 you put out last year the average annual output from that pond?

MR. KOPPLIN: No, we have put out more than that from time to time, but it just depends with us on how the fish commissioners feel about the distribution. If they want me to hold the fish over until fall, we do not get that number.

MR. MEEHAN: How many have you put out from that pond this year?

MR. KOPPLIN: We made two trips with the fish car, and have taken out already about 50,000 fish.

MR. MEEHAN: What is your estimate of the number there now?

MR. KOPPLIN: About 40,000, that is as close as we can approximate.

MR. MEEHAN: What is the greatest number you have put out from that pond in one season?

MR. KOPPLIN: As most of these gentlemen who have had experience with young bass know, when they are swarming you can put out about the numbers you want. We have put out as high as 450,000 fish.

MR. MEEHAN: And those, of course, were nearly all advanced fry?

MR. KOPPLIN: They were all fry and advanced fry. They were distributed within a month after hatching.

MR. MEEHAN: You have never had anything, of course, but the large-mouth bass there?

MR. KOPPLIN: Some of the small-mouth have spawned there, but we never tried them to any great extent. I have just put the small-mouth in one of the small ponds to see how they will do, but we have never had much in the way of results, because our smaller lakes are not good bass lakes.

MR. MEEHAN: Have you ever tried the experiment of having more females in the pond than just exact pairs?

MR. KOPPLIN: No, we always tried to pair them off as nearly as possible.

MR. MEEHAN: You have tried, say, three to two?

MR. KOPPLIN: No.

MR. MEEHAN: You think they all paired up?

MR. KOPPLIN: Well, no, they did not; I saw quite a few loafers.

MR. R. S. JOHNSON, Washington, D. C.: I would like to ask if the bass distributed were counted or estimated?

Mr. Kopplin: They were counted. Any one visiting those lakes in the spring would have an idea about the number of young fish.

Mr. C. W. Willard, Westerly, R. I.: I would like to ask if you make any attempt at artificial feeding?

Mr. Kopplin: No, except in the smaller ponds. We tried it year after year and cut up a lot of crayfish, lungs, etc., but in our 60 acres of water there is about enough natural food so we get along without artificial food.

Mr. Meehan: What food have you in those lakes outside of crayfish, daphnia, cyclops, etc.?

Mr. Kopplin: The water is alive with all kinds of insects.

Mr. Meehan: Do you see swimming in there a small, crab-like creature, very minute?

Mr. Kopplin: Myriads of them.

Mr. Meehan: That is the secret of your success, is it not?

Mr. Kopplin: For a long time I doubted whether or not they were young bass, but they were much smaller. In my early experience the water was muddy, and it was hard to determine.

Mr. Worth: Does the President refer to the fresh-water flea in his question?

Mr. Meehan: I refer to the daphnia.

Mr. Kopplin: We have experts from the Washington University, and I depend on them in these technical matters. I know my fish well and their technical names, but I am not very familiar with the various forms of insects, or at least their technical names.

Mr. Meehan: Those of us who have been specially interested in bass culture and have had to struggle a great deal have been very much interested in this work.

Mr. W. T. Thompson, Fairport, Iowa: Mr. Worth referred to the probability that the goldfish would spawn during the season and furnish a great deal of food, and I would like to ask if such is the case. Also reference has been made to the shore line, and I would like to ask whether the bulk of the pond area was not shallow and only occasionally deep. I judge the pond was 6 or 7 feet deep at the maximum, but wondered whether the greater portion was not shallow.

Mr. Kopplin: It is 6 feet in the centre going to a feather-edge.

Mr. Worth: I would like to ask the gentleman to tell the meeting how the spawning sod is put down. He uses cut sod for the spawning bed for the large-mouth black bass. How far apart and how near the shore are the beds placed?

Mr. Kopplin: For years we used nothing but gravel until we found fish spawning on willow roots, preferable to sand, and that they would work down to solid clay. We have been using goldfish for years for food. There has been an unusual growth of goldfish this year. Ordinarily we do not get so many goldfish, as they are devoured, but they got a good start this year. The goldfish spawned on the sod in about a foot of water, and I noticed bass took possession of this sod; so I have been using the sod very extensively for bass nests, placing them 15 feet apart in 12 to 18 inches of water.

MR. G. W. N. BROWN, Homer, Minn.: In how large pieces?

MR. KOPPLIN: About the size of an ordinary chair bottom.

MR. BROWN: Of what thickness?

MR. KOPPLIN: About 3 inches.

MR. BROWN: Do you leave the grass side of the sod up?

MR. KOPPLIN: The grass is not long—only about 1 inch to 2 inches high. The bass are constantly working over there sweeping the sediment off the surface.

MR. MEEHAN: Don't you think that after the young bass have started to grow, if you made an examination of the sod early in the morning you would find young fish feeding on the eggs of the goldfish, or wherever they deposited their eggs, thus furnishing a lot of food for the little bass?

MR. KOPPLIN: Yes.

MR. WILLARD: Have you noticed particularly whether your little bass feed more generally upon the spawn of the goldfish, or do they feed upon the little goldfish? Have you seen them feed on the very minute goldfish?

MR. KOPPLIN: Yes.

MR. WILLARD: Don't the little bass catch them?

MR. KOPPLIN: Yes. I notice that the goldfish are hot after their own eggs; but I have not noticed the bass.

MR. BUCK: Have you had any trouble with the adult goldfish eating the eggs of the bass?

MR. KOPPLIN: The poor goldfish are scared they are afraid of the bass and do not eat their eggs.

MR. WORTH: About that matter of the algæ, I would like to understand what plant it is—while Dr. Forbes and Dr. Bean are here, who actually know what such things are. From Dr. Hugh M. Smith's excellent book, on the Japanese Goldfish, I derived the idea that the algæ were very many very small floating plants, so small that they were microscopic and constituted the food of crustaceans which are in themselves sufficiently small to comprise the food of black bass fry. But now it seems they are speaking of a massive growth that is floating on the surface of the water, that is in strands, in threads, green like a plant, and called frog spittle.

MR. KOPPLIN: That is it.

MR. WORTH: What is the scientific name of that frog spittle?

DR. FORBES: There are a great many species of what are called filamentous algæ. The various species of *Spirogyra* are such forms; but there is often a great mixture of species in a single film or sheet of algæ on the surface of a pool. Some consist of single separate cells; but the threadlike algæ are composed of a series of cells joined end to end. They form by their interlacing a web composed of long threads and strands, among which single minute cells and a variety of other forms may be entangled. They all come under the general name of algæ, which is a botanical name, however, rather than a practical one.

Mr. Worth: I will ask Mr. Kopplin whether those goldfish this summer destroyed any of the bottom growth of plants in the ponds, or whether it was the surface plants alone?

Mr. Kopplin: The surface plants. Our lakes can be drained well, and that would get rid of the moss in the fall of the year. In raising carp I would go to Illinois and get algæ starting from the bottom. It settles down on the bottom of the pond in the winter and comes up again in the spring. It got such a start one year that I could not work with my bass; so I put about 50 or 60 carp in one pond where they spawned. Thousands of little carp resulted and they killed off the moss.

Dr. Bartlett: They are good for something then.

Mr. Meehan: What is that moss you are speaking of?

Dr. Forbes: Not the chara. We have almost none in this state. Probably it is one of the milfoils.

Mr. Kopplin: It is the stuff you cannot get through with a boat.

Professor Dyche: You put the carp in with the young bass?

Mr. Kopplin: No, in with the adult bass in the spring.

Professor Dyche: It is stated that in four days after a certain number of goldfish were put in there certain forms of fresh water algæ disappeared. It is not probable that goldfish in four days would destroy such algæ, especially where there is a mass of the material all through the ponds, as we understand it. As a matter of fact the fresh water algæ, and particularly the species of *Spirogyra*, disappear sometimes in a week's time without goldfish. After the plant once has its growth and development it sometimes rapidly disappears. We have noticed that in our ponds. There is such a vast number of things connected with the relationship of plant life and fish life in any pond, that I have deemed it wise to get the consent of the Kansas Legislature and Board of Regents of the University of Kansas to study this subject. Since we have been put in charge of the Kansas State fish hatchery we have undertaken to found a fish hatchery based primarily on the food habits of fish. In this line there seem to be many problems that are unsolved. We have gotten together the best information regarding bass culture that it was possible to get from the reports of this Society, and with all due deference to all the gentlemen who have written on the subject of black bass, after you have summed it up there seems to be considerable that is not known, particularly with regard to what young bass eat.

In regard to insects in the pond, many of them look very good, but they are not eaten by the fish at all. The only way we can find out what the fish eat and do is to study the habits of the fish. We have opened the stomachs of several thousand fish and studied them. We have studied the stomachs of between 1,100 and 1,200 German carp and we have on hand 2,700 stomachs taken in May and June, to work up;

however, having your nose in carp entrails continuously for hours to determine contents of stomachs and intestines is not the most pleasant work. We are planning to put up a building to be used as a laboratory for the state fish hatchery, for the purpose of studying plants, insects, and fish and their relationships. You will all be welcome to come to the Kansas State hatchery and work when this building is constructed The building will be primarily for the students of the University of Kansas, but students from other universities and colleges will be welcomed to carry on certain investigations which should be carried on to clear up a considerable number of problems connected with fish culture, and particularly the black bass, perhaps the best known and most highly prized fish in the interior part of the country.

In my paper I will refer to the fact that we are building 83 new ponds for the special purpose of raising black bass, crappie, blue gills, sunfish and catfish; but we raise many of them in the same pond; and we may say also that many of these ponds are intended for black bass. The subject of plant life in its relation to insect life, and plant life and insect life in relation to fish life, particularly young fish life, is a subject upon which it seems very hard to get any definite information. We hope with a laboratory for such investigations that something may be found out about fishes, especially the young fishes, that will be a little more definite; and when we come to stock a pond with fish it will also be stocked with the proper plants. This will enable the ponds to be managed so that the plant life will aid the fish life. This is one of the ideas we hope to carry out in the development of this new hatchery.

Mr. Worth: Before we leave this question of the bass I want to say that this matter of the plant growth in bass ponds is a very serious one. There are some ponds which can be drawn in the winter time to freeze this moss out. Even then it is only partially killed. But at stations where the water is scarce, they cannot afford to draw ponds down every time they want to get the moss out; and during the winter season with fish contained in ponds, the water cannot be drawn off for freezing purposes.

Our moss this year had to be removed. The usual method was to take a flat-bottomed boat or skiff and use rakes, but this was laborious and expensive and cost altogether too much. Then I undertook to cut the moss out from the shore, and used barbed wire made fast to small rope, dropped it on the bottom and sawed back and forth. In this way we cut out a good deal of the moss, but not all. Then I put chains on the barbed wire and found that they went down into the soft mud and cut underneath the plants, and after all we had to go over the ponds with rakes. Then I thought to obtain discarded band saws which I riveted together, making something that would have the weight to keep it on the bottom and still have the breadth to prevent it from going into the mud, so that it would cut the plants off at the bottom, like cutting down hay. I did not apply the band saw idea; but in discussing it with others whom I thought would take an interest I learned that there is a saw of the kind already made, and that it is on sale somewhere; it has teeth on but one side, and in order to make a doubled-edged saw it is turned over, while hot, every six inches.

MR. FEARING: A man named Ziemsen advertises it in the *London Fishing Gazette.*

MR. MEEHAN: There was an exhibition of a machine similar to that at the Toledo meeting in 1909. The demonstration was made in an artificial stream at the Castalia Club. It was quite successful. I have sympathized a great deal with Mr. Worth because the method he pursued in raking and hauling is what we have had to do ourselves, to keep our ponds clear of the chara moss.

MR. BROWN: I would like to ask Dr. Bean if this *Simulium* must have rippling water, or a current in which to propagate, as Dr. Forbes mentioned?

DR. BEAN: No, it propagates in the pond, which is the ordinary pond with an inflow and outflow. It is true there is a good flow of water through it, but it does not make ripples on the surface. We have put nothing in to cause ripples, and yet in the ordinary bass and crappie ponds this *Simulium* develops in enormous numbers.

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'98 Rogers, J. M., 159 La Salle Street, Chicago, Ill.

'10 Roggensack, E. J., Lansing, Iowa.

'99 Root, Henry T., Harbor Commission, State House, Providence, R. I.

'10 Roquemore, C. H., Montgomery, Ala.

'98 Rosenberg, Albert, Kalamazoo, Mich.

'11 Rote, E. E., U. S. Bureau of Fisheries, Homer, Minn.

'10 Rowe, Henry C., Groton, Conn.

'11 Ruckman, Chas. W., U. S. Bureau of Fisheries, Homer, Minn.

'09 Runion, H. P., Bankleman, Nebr.

'07 Russel, Henry, Michigan Central R. R., Detroit, Mich.

*'05 SAFFORD, W. H., Missouri Fish Commission, St. Joseph, Mo.

'05 SALMON, ALDEN, South Norwalk, Conn.

'07 SAMSON, JAMES B., 320 Lewis Building, Pittsburgh, Pa.

'02 SAUNDERS, DR. H. G., Chattanooga, Tenn.

'10 SAUNDERS, H. P., Roswell, New Mexico.

'08 SAUNDERS, J. P., Deerwood, Minn.

'10 SCHMAUSS, LEONARD W., U. S. Bureau of Fisheries, Leadville, Colo.

'11 SCHMITT, WALDO, U. S. Bureau of Fisheries, Washington, D. C.

'10 SCHNOOR, JACOB, Belford, N. J.

'00 SEAGLE, GEORGE A., U. S. Bureau of Fisheries, Wytheville, Va.

'10 SEAL, WM. P., Delair, N. J.

'00 SELLERS, M. G., 1306 Arch Street, Philadelphia, Pa.

'10 SHEBLEY, FRANK A., Superintendent Santa Cruz County Hatchery, Brookdale, Cal.

'91 SHERWIN, H. A., 100 Canal Street, Cleveland, Ohio.

'10 SHIELDS, G. O., 1061 Simpson St., New York City.

'11 SHINN, JAMES A., Department of Game and Fish, Denver, Colo.

'11 SHIRA, AUSTIN F., U. S. Bureau of Fisheries, Homer, Minn.

'08 SHIRAS, GEO., 3d, Stoneleigh Court, Washington, D. C.

'06 SHORTAL, J. M., 906 Chestnut St., St. Louis, Mo.

'03 SHURTLEFF, MERRILL, Lancaster, N. H.

'10 SIEURIN, P. G., Director Central Swedish Fish Hatchery Co., Kloten, Sweden.

'03 SIMMONS, WALTER C., Providence, R. I.

'01 SINGLETON, JAMES H., Woonsocket, R. I.

'03 SLADE, GEORGE P., 309 Broadway, P. O. Box 283, New York City.

'11 SMITH, EMMETT VANCE, Chief Deputy, State Game, Fish and Oyster Commission, Box 217 Capitol Sta., Austin, Texas.

'10 Smith, Miss Ethel M., U. S. Bureau of Fisheries, Washington, D. C.

'91 Smith, Dr. Hugh M., U. S. Deputy Commissioner of Fisheries, Washington, D. C.

'10 Smith, Irving Edward, 1532 16th St. N.W., Washington, D. C.

'99 Smith, Lewis H., Algona, Iowa.

'08 Smith, Richard, Waukegan, Ill.

'05 Snyder, J. P., U. S. Bureau of Fisheries, Bozeman, Mont.

'11 Southall, John B., U. S. Bureau of Fisheries, Fairport, Iowa.

'99 Southwick, J. M. K., Newport, R. I.

'08 Speaks, John C., Chief Warden Ohio Fish and Game Commission, Columbus, Ohio.

'87 Spensley, Calvert, Mineral Point, Wis.

'10 Stack, F. George, Sabattis, N. Y.

'07 Stanton, W. C., International Falls, Minn.

'04 Stapleton, M. F., U. S. Bureau of Fisheries, Manchester, Iowa.

'00 Starr, W. J., State Board of Fish Commissioners, Eau Claire, Wis.

'10 Stead, David G., Fisheries Department, Sydney, New South Wales, Australia.

'11 Sterett, W. G., State Game, Fish and Oyster Commissioner, Port Lavaca, Texas.

'03 Steele, G. F., Port Edwards, Wis.

'03 Stevens, Arthur F., 227 West Grand St., Elizabeth, N. J.

'05 Stevenson, Charles H., 511 Moffat Building, Detroit, Mich.

'08 Stiles, Robt., U. S. Bureau of Fisheries, Bozeman, Mont.

'08 Stone, J. W., 921 University Ave., Madison, Wis.

'04 Story, John A., U. S. Bureau of Fisheries, Green Lake, Me.

'04 STOTZ, MARTIN, 1132 Land Title Building, Philadelphia, Pa.

'98 STRANAHAN, F. A., Cleveland, Ohio.

'88 STRANAHAN, J. J., Bullochville, Ga.

'04 SUMNER, DR. FRANCIS B., U. S. Bureau of Fisheries, Washington, D. C.

'04 SURBER, THADDEUS, U. S. Bureau of Fisheries, Fairport, Iowa.

'11 SWIFT, H. F., 307 Crocker Building, San Francisco, Cal.

'10 SWORD, C. B., New Westminster, British Columbia, Canada.

'97 SYKES, HENRY, Wisconsin Fish Commission, Bayfield, Wis.

'10 SYLVESTER, RICHARD, Municipal Building, Washington, D. C.

'04 TALBOTT, HENRY, Interstate Commerce Commission, Washington, D. C.

'03 TEAL, J. N., Worcester Block, Portland, Ore.

'99 THAYER, W. W., U. S. Bureau of Fisheries, Northville, Mich.

'06 THOMAS, W. H., U. S. Bureau of Fisheries, Fairport, Iowa.

'05 THOMPSON, GEORGE B., Davis, W. Va.

'05 THOMPSON, JAMES F., Martinsburg, W. Va.

'00 THOMPSON, W. P., 112 Broad Street, Philadelphia, Pa.

'00 THOMPSON, W. T., U. S. Bureau of Fisheries, Bozeman, Mont.

'08 THOMSON, G. H., Estes Park, Colo.

'10 TIERNEY, JAS. N., Roxbury, Vt.

'92 TITCOMB, JOHN W., Commissioner of Fisheries and Game, Lyndonville, Vt.

'11 TONGUE, LEONARD M., U. S. Bureau of Fisheries, Washington, D. C.

*'01 TOWNSEND, DR. CHARLES H., Director New York Aquarium, New York City.

'99 TUBBS, FRANK A., U. S. Bureau of Fisheries, Neosho, Mo.

'98 TULIAN, EUGENE A., care Board for the Protection of Birds, Game and Fish, New Orleans, La.

*'11 VALETTE, LUCIANO H., Chief of Section of Fish Culture, 827 Rivadavia, Buenos Aires, Argentina.

'09 VAN ATTA, CLYDE H., U. S. Bureau of Fisheries, Leadville, Colo.

'10 VAN SICKLEN, F. W., 36 Spear St., San Francisco, Cal.

'10 VILES, BLAINE S., Inland Fish and Game Commissioner, Augusta, Me.

'00 VINCENT, W. S., U. S. Bureau of Fisheries, Tupelo, Miss.

'11 VIQUESNEY, J. H., State Game and Fish Warden, Belington, W. Va.

'00 VOGELSANG, ALEXANDER T., 20 Montgomery St., San Francisco, Cal.

'09 VON LENGERKE, J., 200 Fifth Ave., New York City.

'06 WADDELL, JOHN, Grand Rapids, Mich.

'96 WALKER, BRYANT, Detroit, Mich.

'11 WALKER, DR. H. T., 210 Main St., Denison, Texas.

'08 WALLACE, JOHN H., JR., Commissioner Department of Game and Fish, Montgomery, Ala.

'03 WALLICH, CLAUDIUS, U. S. Bureau of Fisheries, Concrete, Wash.

'96 WALTERS, C. H., Cold Spring Harbor, N. Y.

'98 WARD, PROF. H. B., University of Illinois, Urbana, Ill.

'03 WATERHOUSE, REV. E. M., Broadway and 71st St., New York City.

'08 WEBB, W. M., State Shellfish Commissioner, Morehead City, N. C.

'92 WEBB, W. SEWARD, 44th St. and Vanderbilt Ave., New York City.

'07 WEBSTER, B. O., Wisconsin Fish Commission, Madison, Wis.

'08 WEBSTER, H. A., Oregon City, Ore.

'01 WENTWORTH, E. E., U. S. Bureau of Fisheries, Concrete, Wash.

'08 WESSEL, JOSEPH A., Secretary Board of Game and Fish Commissioners, Crookston, Minn.

'01 WHEELER, CHARLES STETSON, Union Trust Building, San Francisco, Cal.

'06 WHIPPLE, JAS. S., Albany, N. Y.

'02 WHISH, JOHN D., Albany, N. Y.

'04 WHITAKER, ANDREW R., State Fishery Commission, Phoenixville, Pa.

'96 WHITE, R. TYSON, 320 Bridge Street, Brooklyn, N. Y.

'10 WHITMAN, EDWARD C., Canso, Nova Scotia, Canada.

'11 WIDMYER, EDGAR R., U. S. Bureau of Fisheries, Homer, Minn.

'89 WILBUR, H. O., 235 Third St., Philadelphia, Pa.

'99 WILLARD, CHARLES W., President Inland Fisheries Commission, Westerly, R. I.

'01 WILSON, C. H., Glens Falls, N. Y.

'11 WILSON, J. S. P. H., Chairman, Board of Inland Game and Fish Commissioners, Auburn, Me.

'10 WINCHESTER, GRANT E., Forest, Fish and Game Commission, Bemus Point, N. Y.

'00 WINN, DENNIS, U. S. Bureau of Fisheries, Oregon City, Ore.

'99 WIRES, S. P., U. S. Bureau of Fisheries, Duluth, Minn.

'05 WOLTERS, CHAS. A., Oxford and Mervine Streets, Philadelphia, Pa.

'97 WOOD, C. C., Plymouth, Mass.

'11 WORTH, HENRY B., U. S. Bureau of Fisheries, Washington, D. C.

'84 WORTH, S. G., U. S. Bureau of Fisheries, Mammoth Spring, Ark.

'10 WURZBURG, L., Ketchikan, Alaska.

'09 YERINGTON, EDWARD B., Board of State Fish Commissioners, Carson City, Nev.
'10 YOUNG, CAPT. CARL C., 2 Mt. Vernon St., Gloucester, Mass.
'06 YOUNG, CAPT. JOHN L., Atlantic City, N. J.

'99 ZALSMAN, P. G., Wisconsin Fish Commission, Wild Rose, Wis.

Recapitulation

HONORARY	76
CORRESPONDING	19
ACTIVE (including life members)	543
TOTAL MEMBERSHIP	638

CONSTITUTION

(As amended to date)

ARTICLE I

NAME AND OBJECT

The name of this Society shall be American Fisheries Society. Its object shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of all interests of fish culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II

MEMBERS

Any person shall, upon a two-thirds vote and the payment of two dollars, become a member of this Society. In case members do not pay their fees, which shall be two dollars per year after the first year, and are delinquent for two years, they shall be notified by the treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

The President (by name) of the United States and the Governors (by name) of the several States shall be honorary members of the Society.

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

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, an assistant 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.

In addition to the officers above named there shall be elected annually five vice-presidents who shall be in charge of the following five divisions or sections:

1. Fish culture.
2. Commercial fishing.
3. Aquatic biology and physics.
4. Angling.
5. Protection and legislation.

ARTICLE IV

MEETINGS

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting, or, in default of such action, by the executive committee.

ARTICLE V

ORDER OF BUSINESS

1. Call to order by president.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
    a. President.
    b. Secretary.
    c. Treasurer.
    d. Vice-Presidents of Divisions.
    e. Standing committees.

5. Committees appointed by the president.
    a. Committee of five on nomination of officers for ensuing year.
    b. Committee of three on time and place of next meeting.
    c. Auditing committee of three.
    d. Committee of three on program.
    e. Committee of three on publication.
    f. Committee of three on publicity.
6. Reading of papers and discussion of same.
    (Note—In the reading of papers preference shall be given to the members present.)
7. Miscellaneous business.
8. Adjournment.

ARTICLE VI

CHANGING THE CONSTITUTION

The constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting, provided at least fifteen members are present at said regular meeting.

DR. HUGH M. SMITH
United States Commissioner of Fisheries
Deputy United States Commissioner of Fisheries, 1903-1913
In charge of Scientific Inquiry, United States Fish Commission, 1897-1903
In charge Division of Fisheries, United States Fish Commission, 1892-1897
Secretary-General Fourth International Fishery Congress, Washington, 1908
President American Fisheries Society, 1908

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

FORTY-SECOND ANNUAL MEETING

September 3, 4 and 5, 1912

AT

DENVER, COLORADO

WASHINGTON
PUBLISHED BY THE SOCIETY
1913

Officers

1911-1912

Elected at the Forty-first Annual Meeting in St. Louis, Mo., for the ensuing year, including the meeting to be held in Denver, Colo., beginning September 3, 1912.

President............................S. F. FULLERTON, St. Paul, Minn.
Vice-President................CHARLES H. TOWNSEND, New York City
Recording Secretary..............WARD T. BOWER, Washington, D. C.
Assistant Recording Secretary....ETHEL M. SMITH, Washington, D. C.
Corresponding Secretary..........HUGH M. SMITH, Washington, D. C.
Treasurer............................C. W. WILLARD, Westerly, R. I.

Vice-Presidents of Divisions

Fish Culture......................JOHN W. TITCOMB, Lyndonville, Vt.
Aquatic Biology and Physics..........EDWIN LINTON, Washington, Pa.
Commercial Fishing..............A. B. ALEXANDER, Washington, D. C.
Angling............................H. WHEELER PERCE, Chicago, Ill.
Protection and Legislation...........T. S. PALMER, Washington, D. C.

Executive Committee

HENRY B. WARD, *Chairman*, Urbana, Ill.; DANIEL B. FEARING, Newport, R. I.; E. HART GEER, Hadlyme, Conn.; D. H. POWER, Suttons Bay, Mich.; A. R. WHITAKER, Phoenixville, Pa.; R. TYSON WHITE, Brooklyn, N. Y.; W. L. MAY, Denver, Colo.

1912-1913

Elected at the Forty-second Annual Meeting in Denver, Colo., for the ensuing year, including the meeting to be held at Boston, Mass., beginning September 8, 1913.

President...................CHARLES H. TOWNSEND, New York, N. Y.
Vice-President..........................HENRY B. WARD, Urbana, Ill.
Recording Secretary..............WARD T. BOWER, Washington, D. C.
Assistant Recording Secretary...
Corresponding Secretary..............GEORGE W. FIELD, Sharon, Mass.
Treasurer............................C. W. WILLARD, Westerly, R. I.

Vice-Presidents of Divisions

Fish Culture............................JAMES NEVIN, Madison, Wis.
Aquatic Biology and Physics................L. L. DYCHE, Pratt, Kan.
Commercial Fishing................W. J. HUNSAKER, Saginaw, Mich.
Angling............................H. WHEELER PERCE, Chicago, Ill.
Protection and Legislation..........T. S. PALMER, Washington, D. C.

Executive Committee

DANIEL B. FEARING, *Chairman*, Newport, R. I.; N. R. BULLER, Harrisburg, Pa.; ERNEST SCHAEFFLE, San Francisco, Cal.: J. QUINCY WARD, Frankfort, Ky.; DWIGHT LYDELL, Comstock Park, Mich.; GEORGE W. MILES, Indianapolis, Ind.; GEORGE H. GRAHAM, Springfield, Mass.

AMERICAN FISHERIES SOCIETY

Organized 1870

The first meeting of the Society occurred December 20, 1870. The organization then effected continued until February, 1872, when the second meeting was held. Since that time there has been a meeting each year, as shown below. The respective presidents were elected at the meeting, at the place, and for the period shown opposite their names, but they presided at the subsequent meeting.

PRESIDENTS, TERMS OF SERVICE, AND PLACES OF MEETING

1. William Clift.........1870-1872....New York, N. Y.
2. William Clift.........1872-1873....Albany, N. Y.
3. William Clift.........1873-1874....New York, N. Y.
4. Robert B. Roosevelt...1874-1875....New York, N. Y.
5. Robert B. Roosevelt...1875-1876....New York, N. Y.
6. Robert B. Roosevelt...1876-1877*...New York, N. Y.
7. Robert B. Roosevelt...1877-1878....New York, N. Y.
8. Robert B. Roosevelt...1878-1879....New York, N. Y.
9. Robert B. Roosevelt...1879-1880....New York, N. Y.
10. Robert B. Roosevelt...1881-1882....New York, N. Y.
11. Robert B. Roosevelt...1881-1882....New York, N. Y.
12. George Shepard Page.1882-1883....New York, N. Y.
13. James Benkard ....1883-1884....New York, N. Y.
14. Theodore Lyman......1884-1885....Washington, D. C.
15. Marshall McDonald...1885-1886....Washington, D. C.
16. W. M. Hudson........1886-1887....Chicago, Ill.
17. William L. May.......1887-1888....Washington, D. C.
18. John H. Bissell........1888-1889....Detroit, Mich.
19. Eugene G. Blackford..1889-1890....Philadelphia, Pa.
20. Eugene G. Blackford..1890-1891....Put-in Bay, Ohio.
21. James A. Henshall....1891-1892....Washington, D. C.
22. Herschel Whitaker....1892-1893....New York, N. Y.
23. Henry C. Ford........1893-1894....Chicago, Ill.
24. William L. May.......1894-1895....Philadelphia, Pa.
25. L. D. Huntington......1895-1896....New York, N. Y.
26. Herschel Whitaker....1896-1897....New York, N. Y.
27. William L. May.......1897-1898....Detroit, Mich.
28. George F. Peabody....1898-1899....Omaha, Neb.
29. John W. Titcomb.....1899-1900....Niagara Falls, N. Y.
30. F. B. Dickerson.......1900-1901....Woods Hole, Mass.
31. E. E. Bryant..........1901-1902....Milwaukee, Wis.
32. George M. Bowers....1902-1903....Put-in Bay, Ohio.
33. Frank N. Clark.......1903-1904....Woods Hole, Mass.
34. Henry T. Root......1904-1905....Atlantic City, N. J.
35. C. D. Joslyn...........1905-1906....White Sulphur Springs, W. Va.
36. E. A. Birge...........1906-1907....Grand Rapids, Mich.
37. Hugh M. Smith.......1907-1908....Erie, Pa.
38. Tarleton H. Bean.....1908-1909....Washington, D. C.
39. Seymour Bower.......1909-1910....Toledo, Ohio.
40. William E. Meehan....1910-1911....New York, N. Y.
41. S. F. Fullerton........1911-1912....St. Louis, Mo.
42. Charles H. Townsend..1912-1913....Denver, Colo.

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*A special meeting was held at the Centennial Grounds, Philadelphia, Pa., October 6 and 7, 1876.

CERTIFICATE OF INCORPORATION OF THE AMERICAN FISHERIES SOCIETY

We, the undersigned, persons of full age and citizenship of the United States, and a majority being citizens of the District of Columbia, pursuant to and in conformity with sections 599 to 603, inclusive, of the Code of Law for the District of Columbia enacted March 3, 1901, as amended by the Acts approved January 31 and June 30, 1902, hereby associate ourselves together as a society or body corporate and certify in writing:

1. That the name of the Society is the AMERICAN FISHERIES SOCIETY.

2. That the term for which it is organized is nine hundred and ninety-nine years.

3. That its particular business and objects are 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; to unite and encourage all interests of fish culture and the fisheries; and to treat all questions of a scientific and economic character regarding fish; with power:

a. To acquire, hold and convey real estate and other property, and to establish general and special funds.

b. To hold meetings.

c. To publish and distribute documents.

d. To conduct lectures.

e. To conduct, endow, or assist investigation in any department of fishery and fish-culture science.

f. To acquire and maintain a library.

g. And, in general, to transact any business pertinent to a learned society.

4. That the affairs, funds and property of the corporation shall be in general charge of a council, consisting of the officers and the executive committee, the number of whose members for the first year shall be seventeen, all of whom shall be chosen from among the members of the Society.

Witness our hands and seals this 16th day of December, 1910.

SEYMOUR BOWER	(Seal)
THEODORE GILL	(Seal)
WILLIAM E. MEEHAN	(Seal)
THEODORE S. PALMER	(Seal)
BERTRAND H. ROBERTS	(Seal)
HUGH M. SMITH	(Seal)
RICHARD SYLVESTER	(Seal)

Recorded April 15, 1911.

CONTENTS

PART I

BUSINESS SESSIONS

Transactions of the American Fisheries Society

Forty-second Annual Meeting, held at Denver, Colo., Tuesday, Wednesday and Thursday, September 3, 4 and 5, 1912.

Tuesday, September 3, 1912

Meeting called to order at 11.00 a.m. by the President, Mr. S. F. Fullerton, of St. Paul, Minn.

PRESIDENT'S ADDRESS

Gentlemen of the American Fisheries Society: I want to take this opportunity to personally thank you for the great honor you conferred on me at St. Louis last year. The honor is all the more appreciated, for the reason of my unaccountable absence at that time.

This Society, of which we are all so proud, is only in the infancy of its usefulness. The public is only beginning to realize the great benefit the artificial propagation of fish is to the state and also to the individual in the supply of cheaper food for his table, and in furnishing to the sportsman and lover of nature the recreation and pleasure derived from an outing on any of our lakes and streams.

If there were no fish in the waters, a large part of the pleasure of the outing would be gone. The different states are doing great work in making appropriations to carry on this splendid work. The United States Bureau of Fisheries, under the able management of the Hon. George

M. Bowers and his efficient assistants, is showing to the world what Americans can do in fish propagation. But, as I said in the beginning, the usefulness of this Society is only in its infancy. Great things must be accomplished by our fish doctors and scientists to combat the diseases that fish are heir to. But I have no doubt that this problem will be met and solved correctly.

As a nation we have been criminally wasteful of nearly all of our national resources. We have cut the timber from the headwaters of our streams and around our lakes, and what is the result? The disappearance of the water, and without the water we cannot have fish. We should begin to remedy the mistakes made and reforest around the headwaters of our streams and along our rivers, and in time get back much of that which has been lost.

It is a paying investment outside of the benefits derived in conserving our water supply. We have all seen bare hillsides where the timber has been cut away—and what looks more bleak and desolate? Also we are polluting many of the waters that we already have. There is not a man here present who does not know of some river or lake that has been made unfit for fish by pollution of some kind. It may be sewage or sawdust or some chemical from a tannery or packing plant, or some other of a dozen pollutions which some man or firm under the guise of commercialism—like religion, that word covers a multitude of sins—dumps into our lakes or rivers, not caring whether he destroys the fish in that lake or stream which belong to all the people in their sovereign capacity. But if you raise your voice in protest the cry goes up that you are interfering with business, that you will drive "Mr. Smith" to the rival city. Thus we lose the tannery if the owners are not allowed to do as they please.

Gentlemen, did you ever stop to think how we have been sitting idly by and letting things like this happen? It is our own fault. We have the remedy in our own hands, and if the American Fisheries Society will only start a campaign against water pollution, we can soon make our influence felt. Get the greatest power for good in this country interested—I mean the press.

Two of the most beautiful cities in the United States have flowing through their midst the Father of Waters—the great Mississippi. This river has its source in my own state, and in the upper reaches its pure spring water is fit for any use. But in these two cities there are over three-quarters of a million inhabitants. Every sewer empties into this river, making it impossible as a home for any self-respecting fish, a place where no boy wants to go swimming, where there is no pleasure in boating, where the commercial few have spoiled the pleasures of this vast population, but if a voice is raised against the pollution they say that you are stopping the wheels of progress. But I predict that some day the people will rise up in their might and make the authorities stop this pollution, but that will be only when we get our cities to adopt the commission form of government, and the women of this country have the ballot.

Gentlemen, we are all sorry that the Hon. George M. Bowers, United States Commissioner of Fisheries, and many of the station superintendents have been deprived from meeting with us here today. I understand that, by a recent act of Congress, no financial provision is made for expenses of Government employees to attend meetings like the present gathering. We are all sorry that any law or any rule should have prevented these men from attending our meeting, and I want to say here and now that Congress has certainly blundered. Every man in charge of a Government fisheries station derives great benefit by attending our meetings; it is a schooling that does every one good. We get ideas from each other and we profit by them and so does the work of the Bureau. I would like to refer this matter to our Resolution Committee so that the proper action may be taken. We should urge the necessity of having a large representation of employees from the United

States Bureau of Fisheries at our meetings. The American Fisheries Society needs them and they need the help of the American Fisheries Society.

The president then introduced the Hon. Henry J. Arnold, Mayor of Denver, who made an address welcoming the society to the city. Dr. T. S. Palmer, of Washington, D. C., was called upon by the president to respond to the address of welcome.

PRESIDENT: The first order of business will be the roll-call of members. We are all sorry that Mr. Ward T. Bower, our Secretary, is absent in Alaska. However, Mr. Barton D. Evans, of Pennsylvania, has kindly consented to act as Secretary for this meeting.

REGISTERED ATTENDANCE

The registered attendance of members was 52, as follows:

COL. JOSEPH H. ACKLEN, Nashville, Tenn.
G. G. AINSWORTH, Leadville, Colo.
JABE ALFORD, Madison, Wis.
FRANK ANDERSON, Denver, Colo.
IGNATZ BALDUS, Indianapolis, Ind.
O. N. BALDWIN, Leadville, Colo.
D. C. BEAMAN, Denver, Colo.
RUDOLF BORCHERDT, Denver, Colo.
SEYMOUR BOWER, Detroit, Mich.
WILLIAM J. BRYAN, Lincoln, Neb.
NATHAN R. BULLER, Harrisburg, Pa.
EDWIN K. BURNHAM, Washington, D. C.
EUGENE CATTE, Langdon, Kan.
DR. R. E. COKER, Fairport, Iowa.
C. K. CRANSTON, Pendleton, Ore.
H. D. DEAN, Anaconda, Mont.
PROF. L. L. DYCHE, Pratt, Kan.
BARTON D. EVANS, Harrisburg, Pa.
WALLACE EVANS, Oak Park, Ill.
DANIEL B. FEARING, Newport, R. I.
DR. GEORGE W. FIELD, Sharon, Mass.
WILLIAM L. FINLEY, Portland, Ore.
RICHARD E. FOLLETT, Detroit, Mich.
SAMUEL F. FULLERTON, St. Paul, Minn.
GEORGE H. GARFIELD, Brockton, Mass.

H. D. Goodwin, Milwaukee, Wis.
George H. Graham, Springfield, Mass.
W. O. Hart, New Orleans, La.
W. H. Hughes, St. Louis, Mo.
W. J. Hunsaker, Saginaw, Mich.
S. E. Land, Denver, Colo.
Dwight Lydell, Comstock Park, Mich.
C. C. Mason, Hermit, Colo.
William L. May, Denver, Colo.
Geo. W. Miles, Indianapolis, Ind.
W. E. Musgrove, Leadville, Colo.
Jas. Nevin, Madison, Wis.
W. J. O'Brien, Gretna, Neb.
Dr. T. S. Palmer, Washington, D. C.
Richard Parton, Paris, Mo.
Dr. F. L. Riser, Henderson, Colo.
Ernest Schaeffle, San Francisco, Cal.
Leonard W. Schmauss, Leadville, Colo.
Jas. A. Shinn, Denver, Colo.
Franklier Spencer, Jr., Provo, Utah.
G. H. Thomson, Estes Park, Colo.
Dr. Charles H. Townsend, New York City.
C. H. VanAtta, Leadville, Colo.
Prof. H. B. Ward, Urbana, Ill.
J. Quincy Ward, Frankfort, Ky.
R. Tyson White, Brooklyn, N. Y.
C. W. Willard, Westerly, R. I.

THE FOLLOWING VISITORS ALSO ATTENDED

Henry J. Arnold, Mayor of Denver.
S. B. Collins, Lost Lake Fish Hatchery, Creede, Colo.
H. H. Holdaway, Salt Lake City, Utah.
O. E. Johnston, Leadville, Colo.
Smith Riley, District Forester, Denver, Colo.

During the several sessions, the following regular committees were appointed by the President:

Programme: Mr. George H. Graham, Chairman, Massachusetts; Mr. George W. Miles, Indiana; Mr. Dwight Lydell, Michigan.

Nomination of Officers: Mr. Seymour Bower, Chairman, Michigan; Mr. J. Quincy Ward, Kentucky; Mr. Nathan R. Buller, Pennsylvania; Mr. G. H. Thomson, Colorado; Prof. L. L. Dyche, Kansas.

Time and Place of Meeting: Dr. George W. Field, Chairman, Massachusetts; Mr. George W. Miles, Indiana; Mr. Jabe Alford, Wisconsin.

Auditing: Dr. H. B. Ward, Chairman, Illinois; Mr. James Nevin, Wisconsin; Mr. Ernest Schaeffle, California.

Resolutions: Dr. H. B. Ward, Chairman, Illinois; Dr. Charles H. Townsend, New York; Mr. W. L. Finley, Oregon; Mr. W. J. Hunsaker, Michigan; Mr. D. B. Fearing, Rhode Island.

Publication: Dr. Hugh M. Smith, Chairman; Dr. T. S. Palmer; Mr. Ward T. Bower, all of Washington, D. C.

Col. Joseph H. Acklen, President of the National Game Wardens' Association, and Chief Warden of the Department of Game, Fish and Forestry, Nashville, Tenn., then addressed the Society upon "Water Pollution and Other Notes."

PRESIDENT: We shall be glad to hear from Mr. Fearing, of Rhode Island, on the matter of indexing the Transactions of the Society.

MR. DANIEL B. FEARING, Rhode Island: A couple of years ago I volunteered to have an index of the publications of the Society made, and the task was started; but my librarian, who has been doing the work very cheerfully, has informed me that she is going to get married, and has left me. The work will be done, however, and I simply wish to report progress, and that the index will be ready for printing soon.

PRESIDENT: We are greatly indebted to Mr. Fearing for his work.

Through the courtesy of Mr. Wallace Evans, ornithologist, of Oak Park, Ill., and Mr. Richard E. Follett, of the Detroit Zoological Society, Detroit, Mich., the Society was treated to a very interesting and instructive exhibition of colored motion pictures of various wild birds, also of salmon fishing in the north and of the tuna fishing of Italy.

A visit was then made, by means of automobiles furnished by Denver representatives, to the State Fish Hatchery near Denver.

The President called the meeting to order at 3 o'clock p.m., same day, at the Albany Hotel.

PRESIDENT: The first paper will be by Mr. George W. Miles, of Indiana, on "A Defense of the Humble Dogfish."

Mr. Miles then read his paper, which was discussed.

Letters were then read by Mr. Graham from the Hon. George M. Bowers, United States Commissioner of Fisheries, Washington, D. C., from Dr. P. P. C. Hoek, Scientific Fishery Adviser of the Dutch Government, Haarlem, Holland, and from the Hon. W. L. Calderwood, Inspector of Salmon Fisheries for Scotland, Edinburgh, Scotland. These gentlemen wished a successful meeting, and expressed regrets at not being present. In addition, Mr. Calderwood stated that a paper he had prepared for the Society quite a number of years ago had not been published, nor was it returned. He expressed the feeling that he had not received as considerate treatment at the hands of the Society as was due.

MR. FEARING: The gentleman who wrote that letter is an old correspondent of mine. He stands as the highest authority in England today on the salmon; his book entitled "Salmon," published last year, is the final word in respect to that fish. It pains me extremely to consider that a man of his standing and knowledge should have felt as he does Mr. Calderwood is the man of all others who should be made an honorary member of this Society; and it seems to me that the fullest recompense we can make to him is to elect him an honorary member of this Society. I move that he be so elected.

PROF. H. B. WARD, Urbana, Ill.: I second Mr. Fearing's motion. It is undoubtedly true that the trouble was in some way due to the difficulties of international mail service; and the Secretary can write Mr. Calderwood to that effect.

There is no question about his very high standing in the scientific world, and especially in the field of fish culture.

Mr. Calderwood was unanimously elected an honorary member.

PRESIDENT: The people of Denver have been very kind to us and have provided some entertainment for us in the way of a banquet Thursday night. In addition, Mr. G. W. Pell, who deals in fish and oysters and has an extensive business here, has tendered to the members of the American Fisheries Society a banquet on any night that we may choose. The invitation was unanimously accepted for Wednesday evening at 9.30.

MR. WILLARD: I move the election of the following applicants for membership:

NEW MEMBERS

The following 73 persons were elected to membership:

ANDERSON, FRANK, 1331 East Seventh Ave., Denver, Colo.
ANTOINE, CHARLES, 340 South Wabash Ave., Chicago, Ill.
BABCOCK, WILLIAM H., 520 The Rookery, Chicago, Ill.
BAILEY, HOWARD S., Equitable Building, Denver, Colo.
BARNES, ERNEST W., Supt. R. I. Fisheries Experiment Station, Wickford, R. I. (Life.)
BAUER, A., Twenty-fifth and Dearborn Sts., Chicago, Ill.
BELLOWS, I. H., 732 Fullerton Ave., Chicago, Ill.
BONFILS, FREDERICK G., *The Denver Post*, Denver, Colo.
BRYAN, WILLIAM JENNINGS, Lincoln, Neb.
BULLER, G. W., Pleasant Mount, Pa.
BURKE, THOMAS F., Colorado Fish and Game Commission, Denver, Colo.
CALDERWOOD, W. L., Inspector of Salmon Fisheries for Scotland, Edinburgh, Scotland. (Honorary.)
CAMPBELL, WALTER E., Altamosa, Colo.
CAPELL, ARCH. T. P., U. S. Bureau of Fisheries, Leadville, Colo.
CARTER, E. A., Springfield, Mass.
CLEVELAND, DR. GEORGE HENRY, 1909 Ogden Ave., Chicago, Ill. (Resigned.)
CLIFFORD, CHARLES P., First National Bank, Chicago, Ill.
DANGLADE, ERNEST, U. S. Bureau of Fisheries, Washington, D. C.
DEBACA, TRINIDAD C., State Fish and Game Warden, Santa Fe, N. Mex.
DILG, WILL. H., Hearst Building, Chicago, Ill.

ELLIOTT, CHARLES C., 851 Center St., Elgin, Ill.
ENGELBRECHT, P. J., Thomasville, Colo.
FEARING, MRS. D. B., Newport, R. I. (Life.)
FINLEY, W. L., 806 Yeon Building, Portland, Ore.
FLETCHER, EMERY L., Ely, Nev.
FOOT, FRANCIS D., 42 Florentine Gardens, Springfield, Mass.
FORTMANN, HENRY F., 1007 Gough St., San Francisco, Cal. (Life.)
FOUND, WM. A., Department of Marine and Fisheries, Ottawa, Canada.
FRENZEL, A. B., 1540 Sherman Ave., Denver, Colo.
GILSON, ARTHUR, 124 South Main St., Memphis, Tenn.
HALL, JOHN D., U. S. Bureau of Fisheries, Duckabush, Wash.
HAVILAND, JAMES W., Colorado Fish and Game Commissioner, Denver, Colo.
HAYFORD, CHARLES O., Supt. State Fish Hatchery, Hackettstown, N. J.
HEIM, L. C., Marine, Ill.
HESTON, N. C., 6936 South Park Ave., Chicago, Ill. (Resigned.)
HOSSELKUS, BERT. C., Creede, Colo.
HUMMEL, WILLIAM P., Colorado Fish and Game Commissioner, Denver, Colo.
HUNSAKER, W. J., Board of State Fish Commissioners, Saginaw, Mich.
HUSTED, JAMES D., Denver, Colo.
INK, CHARLES, 434 East Market St., Akron, Ohio.
JOHNSON, J. G., Comstock Park, Mich.
JONES, LOMBARD C., Falmouth, Mass.
KEMMERICH, JOSEPH, U. S. Bureau of Fisheries, Washington, D. C.
LEAVITT, PERCY W., P. O. Box 374, Akron, Ohio.
LOESCH, H. C., Colorado Springs, Colo.
MALONE, EUGENE, State Fish Hatchery, Henderson, Colo.
MASON, C. C., Hermit, Colo.
MERRILL, BERTRAM G., Illinois Fish Conservation Society, Hinsdale, Ill.
MUSGROVE, W. E., Leadville, Colo.
NEWCOMB, WILLIAM, Tenafly, N. J.
NEWKIRK, HAWLEY A., 7 West Madison St., Chicago, Ill.
ONDERDONK, CHARLES S., 811 Ideal Building, Denver, Colo.
OTIS, SPENCER, Railway Exchange, Chicago, Ill.
PALMER, MARSHALL G., 96 East Ave., Kankakee, Ill.
PIERCE, HENRY L., Colorado Fish and Game Commission, Denver, Colo.
POTEET, L. A., Deputy Warden, Florence, Colo.
REEME, E. W., Leadville, Colo.
REYNOLDS, B. B., Water Superintendent, Colorado Springs, Colo.
RIBBING, CHARLES A., Hazeltine, Colo.
RISER, DR. F. L., Henderson, Colo.
ROE, S. S., Colorado Fish and Game Commission, Denver, Colo.
SCHAEFFLE, ERNEST, Secretary California Fish and Game Commission, San Francisco, Cal.
SHOPE, S. P., 941 Lawrence Ave., Chicago, Ill.

SPARGUR, ROBERT L., Chief Clerk Colorado Fish and Game Commission, Denver, Colo.

SPENCER, F., Provo, Utah.

SPERRY, E. P., 126 South Euclid Ave., Oak Park, Ill.

STIVERS, D. GAY, Butte Anglers Association, Butte, Mont.

TOWNSEND, DR. CHARLES H., Director New York Aquarium, New York, N. Y. (Life.)

VOGT, JAMES H., Nevada Fish Commission, Carson City, Nev.

WARD, J. QUINCY, Executive Agent, Kentucky Game and Fish Commission, Frankfort, Ky.

WEBER, E. D., P. O. Box 81, Littleton, Colo.

WEHLE, O. C., 5471 Kimbark Ave., Chicago, Ill.

WENTWORTH, NATHANIEL, Fish and Game Commissioner, Hudson, N. H.

PRESIDENT: We have applications from two different places with regard to the place of our next meeting, one from Indianapolis and one from Boston.

There is a matter I would like to bring before the Society in connection with the time and place of meeting, and I would like to have the members of the committee consider it if they will. We have just had a meeting here in Denver of the National Game Wardens' Association. Many of us who are members of that organization belong to the American Fisheries Society. Our work overlaps; one protects and the other propagates. I think it would be a good thing to get the views of some of the members of the National Game Wardens' Association as to their time and place of meeting. They are willing to meet two or three days before or after our meeting. I want to bring this to the attention of the committee.

A paper on the "Protection of Undersized Fish," including exhibits of specimens, was read by Mr. G. H. Thomson. The paper was discussed.

The Secretary's report was then read by the Secretary pro tem, accepted, and placed on file.

REPORT OF THE RECORDING SECRETARY

To the Officers and Members of the American Fisheries Society:

The major part of the Secretary's work since the last meeting of the Society has been the publications of the Transactions. It may have seemed to members that the interval of several months following the St. Louis meeting before the appearance of the volume was unduly long, but it is to be remembered that the editing and arranging of material amounting to 350 printed pages is no slight task. The proof reading and correspondence with authors, not to mention unforeseen delays in the printing, add to the Secretary's duties and still further postpone the issue of the Transactions.

The volume for 1911 contains 22 papers, with 3 illustrations, and the usual business proceedings, the list of members, and other standing or routine matter. Competitive bids for the printing were solicited, and the contract was let to the W. F. Roberts Company, of Washington, D. C. The cost of publishing the edition of 750 copies was $908.21. Dr. H. M. Smith, as chairman of the Publication Committee, was in general charge of the work, which was attended to directly by the Secretary and Assistant Secretary, who are the other two members of the Committee.

It will be recalled that the 1910 report was subject to some criticism for certain blank pages which were considered by some of the members to be unnecessary. It seemed to be agreed, however, that the issue of papers separately was desirable, in certain cases, at all events. To arrange for this it is necessary to have each paper begin on a new odd page, and some blank pages inevitably result. There are a total of 14 such blank pages in the 1911 report, but the printer made a reduced rate on them.

Sales of reports during the year have amounted to $37.70. The Fortieth Anniversary volume (1910) has been sold at $2.00 per copy, the other issues at $1.00, as decided upon by the Society at the St. Louis meeting. Sales would have been larger but for the scarcity of many issues. Several inquiries have come from libraries which desired to obtain a full set of the Transactions.

The number of reports now in the hands of the Secretary, by years, is as follows:

1876	1	1902	6
1888	1	1903	2
1894	1	1904	67
1895	2	1905	2
1896	2	1906	103
1897	2	1907	97
1898	2	1908	122
1899	3	1909	101
1900	4	1910	119
1901	4	1911	89

Deaths of the following members have been reported since the last meeting:

JOHN L. LEARY, San Marcos, Texas. Joined the Society in 1901. Died December 23, 1911.

J. F. ROEPPLE, Fairport, Iowa. Joined 1910. Died January 30, 1912.

JOHN F. HILL, Bangor, Me. Joined 1911. Died March 16, 1912.

The following members have resigned during the past year:

S. ZWIEGHAFT (1892), Philadelphia, Pa. October 21, 1911.
EDWARD I. FROST (1910), Asheville, N. C. October 21, 1911.
JOHN S. SCULLY (1908), Washington, D. C. October 21, 1911.
H. G. THOMAS (1902), Stowe, Vt. October 24, 1911.
JOHN G. RUGE (1898), Apalachicola, Fla. October 25, 1911.
F. W. AYER (1892), Bangor, Me. November 15, 1911.
JOHN M. CRAMPTON (1907), New Haven, Conn. November 18, 1911.
C. W. DORR (1908), Seattle, Wash. December 8, 1911.

Owing to the unusual expense of publishing the Anniversary volume of the Transactions in 1910, a deficit of several hundred dollars faces the Society, and means of raising funds must be considered. Dr. Charles H. Townsend suggests the plan of taking out life memberships, and has taken the lead by sending his own check for this purpose. This plan is commended to the attention of all the members.

By way of suggestion, the attention of the Society is invited to one of its articles of incorporation—namely, that empowering it "to conduct, endow or assist investigation in any department of fishery and fish-culture science." If the present indebtedness be regarded as a hindrance to action of this kind at the present time, the matter may well be kept in mind for the coming year.

During the absence of the Secretary, who has been in Alaska since June, his duties have been discharged by the Assistant Secretary.

Respectfully submitted,

WARD T. BOWER,
Recording Secretary.

JUNEAU, ALASKA, August 8, 1912.

The Treasurer's report was then read and referred to the Auditing Committee.

REPORT OF THE TREASURER

To the American Fisheries Society:

I herewith present my annual report as Treasurer from October 3, 1911, to September 3, 1912:

RECEIPTS.

1911			
	Sale of Reports	$ 37.70	
	Yearly dues	859.00	
	Life membership fees	75.00	
			$971.70

EXPENDITURES.

Oct.	5.	Balance due Treasurer	$563.65	
"	5.	Sundry expenses, St. Louis meeting	1.25	
"	12.	W. H. Gill, lettering certificates	50.00	
"	12.	Ward T. Bower, Sec'ty, sundries	6.60	
"	16.	C. J. Butler, envelopes	10.72	
Nov.	13.	Stamped envelopes	10.72	
"	24.	W. H. Gill, lettering certificates	20.40	
1912				
Jan.	2.	W. F. Roberts Co., by Sec'ty	61.38	
"	2.	Goodwin & McDermott, stenographers	180.00	
Feb.	5.	W. F. Roberts Co. by Sec'ty	7.00	
June	17.	Ward T. Bower, Sec'ty, postage, etc	19.30	
"	27.	W. F. Roberts Co. by Sec'ty	7.75	
"	29.	J. T. Murphy, printing	4.00	
July	15.	Stamped envelopes	10.68	
Aug.	2.	Ethel M. Smith, Ass't Sec'ty, stamps, etc	13.99	
"	7.	Account books and postage	2.00	
"	17.	J. C. Hall Co., receipt books	6.75	
"	29.	Clerical services, various dates	3.50	
		Balance due Treasurer		$ 7.99
				$979.69

Accounts due and payable, W. F. Roberts Co.	$909.56
Total indebtedness	917.55

Respectfully submitted,

C. W. Willard, *Treasurer.*

Westerly, R. I., August 29, 1912.

Mr. George H. Graham, Springfield, Mass.: I would like to ask the Treasurer how many members are in arrears for dues?

Treasurer: I cannot state the exact number, but I think 250. During the past year I have made an earnest effort to collect all the dues possible. To do this I have written at least 150 or 200 personal letters. These letters have brought about all the money that I think we can expect to get from the delinquent list. I do not see how any one that ever expected to pay could fail to respond to the appeals that I sent out. Therefore it would seem to me as if we must either increase the dues or raise a fund in some way to wipe out the present indebtedness.

President: It is a problem the Society will have to take up before the meeting is over.

SUGGESTIONS FOR INCREASING MEMBERSHIP

The Secretary *pro tem* then read a communication from Mr. H. Wheeler Perce, of Chicago, offering suggestions for the enlargement in scope and membership of the Society, as follows:

Chicago, Ill., August 27, 1912.

Mr. Samuel F. Fullerton, Pres't,
American Fisheries Society,
St. Paul, Minn.

Dear Sir:

At the last meeting I gathered that an increased membership was something considered very desirable, and through the year I have not only done my best to secure desirable new members, but have given the question very much thought, and it appears to me wise to suggest to the forthcoming meeting the results.

To the casual or even the interested observer it might seem that the wonderful work of the American Fisheries Society, incalculable in value to the people of this country, does not reach as many of the people as it should, and thus convey to them the educational advantages which the Society produces. It might therefore be advisable to enlarge the membership of the Society and spread abroad its teachings and findings to a greater degree than heretofore.

To this end, let me respectfully suggest that state or district chapters of the Society be formed within its membership, with a state or district chairman presiding over same, and thus permit of more frequent meetings of at least certain groups, which could meet quarterly or, possibly, monthly and thus maintain a continued interest in the various subjects and each year produce a more extended contribution to the annual meeting. In this way local conditions would be more closely studied and reported to the central body and a wider grasp of all situations maintained.

I am moved to this suggestion in view of the great success attending this form of organization in so far as it relates to the American Institute of Architects. For some years I was closely allied with the Illinois chapter of the American Institute of Architects and had occasion to note how well, and with what splendid results, the plan worked. Monthly meetings were held by nearly all the state chapters and a high tension interest in the work was maintained at all times. As a result, the parent body was much benefited, all the great questions of architecture were thoroughly promulgated, and the art was kept on a constantly progressing basis. Much of the great twentieth century architectural beauty of today is directly traceable to the influences exerted by the organization referred to and through its form of organization.

In addition to this, it seems to me that it would be of great value if the American Fisheries Society could maintain a magazine, through which a widespread membership and interest could be promoted in a manner similar to the plan of the National Geographic Society, the success of which, I understand, is more than gratifying, not only from a financial standpoint, but as a means of spreading geographical information.

A magazine devoted to the subjects covered by the American Fisheries Society could undoubtedly be made just as attractive as the "National Geographic Magazine" to the thousands of readers, who would thereby become more fully acquainted with the conditions attaching to fish and fishing. This, I am sure, can be said without fear of contradiction in regard to the vast number of anglers in the United States, who would become ardent adherents of the American Fisheries Society and form one of its strongest supporting branches. It can be said truly of many who engage in sport fishing that they can be educated to a higher degree as to the conservation of fish—not only from a sport standpoint, but from a commercial standpoint—and, thus properly educated, no body of men would be more earnest in supporting good measures.

It can be truthfully said that practically no journal published today treats of fish and fishing in a strictly modern educational manner. The journals are either dominated by the advertising department or run to such an extreme degree of fiction that but little reliance can be placed in what they say. Again, part of them are dominated by some single pet scheme of reform, to the exclusion of some other pet scheme of reform attaching to competing publications, and thus there is no unity of assault upon objectionable practices in connection with fish and fishing, nor any unity in promoting those reforms leading to conditions which those of us who have the entire matter at heart so much desire.

It seems to me almost a certainty that a magazine gotten up with plenty of pictures and plenty of good, solid facts, told in a popular manner, with no domination from the advertising department or no personal "axe to grind," and containing within its covers each month something of vital importance in relation to the subjects listed in the five objects of the American Fisheries Society, would prove a "winner" from the very start and be of tremendous educational value.

I have covered these two suggestions in but a feeble manner, but among the members much in addition will undoubtedly suggest itself, and I simply respectfully submit these suggestions in the hope that they may receive the kindly consideration of the members of the Society, and I am moved so to do solely through a strong and earnest desire to see this greatest and, I believe, oldest conservation society still further increase the efficiency and scope of the wonderful work it has done and is doing through the splendid minds that have unselfishly given of their best to the cause.

Respectfully submitted,

H. Wheeler Perce.

President: This communication is from one of our most active members, and I should like to hear some discussion on it. Mr. Perce has been very active in getting new members.

Mr. G. H. Thomson, Estes Park, Colo.: It seems to me we should take action on the recommendations and suggestions upon the educational line. It has been suggested that this is one of the vital features of the American Fisheries Society. I believe the time is coming when this matter of education along these lines is going to be taken up in our public schools, and there is where it ought to be taken up.

I should like to see a committee appointed to carry out the suggestions of the paper, especially the suggestion of printed matter to circulate in public schools and generally.

Mr. George H. Graham, Springfield, Mass.: I think we must consider the advisability of raising the dues. When the dues were first placed at $2, the reports that were issued were nothing as compared with what the reports are today; and every man that has received the report for the last two years has surely received more than two dollars' worth. No society can give out more than it receives and still have a surplus in the treasury. The report for 1910 cost between $1200 and $1400. Now, if we are taking in $800 in dues and paying out $1200 for reports, where is the rest of the money coming from? I do not think there is a member who would object to paying $3 a year to get this report.

MR. C. K. CRANSTON, Pendleton, Ore.: $3 would not do the business, would it?

MR. ERNEST SCHAEFFLE, San Francisco: There is a balance due now of $970. We must not only meet that, but pay additional running expenses.

MR. GRAHAM: We must have a large membership in order to do it, but even with an increased membership we must make the dues $3; we must consider that such an increase would be cheerfully met.

MR. CRANSTON: I am new in this business. I have only been a member for three years, and this is my first attendance at the meetings; but I have read the copies of the Transactions that have reached me, with a good deal of interest; and I feel perhaps more deeply than I can express the importance of the perpetuation of this Society. It strikes me that a well-planned method to increase the membership might be of advantage. I do not know how well that has been worked out or how thoroughly it has been tried; but perhaps the method I am going to suggest will lead to the betterment of our financial condition. My suggestion is that all persons here should obligate themselves to bring in new members. I feel confident that with the increased dues suggested I can obligate myself to bring in three or four new members. If others are as much interested as I—and I have no doubt many if not all here are—the problem will be solved.

PRESIDENT: I think this matter ought to be taken up in committee and thoroughly discussed, to determine whether it is best to raise the membership fees; or whether it is best to make an appeal to every member here present to secure at least two new members. I started out to get 50 last year, but I got only 12 new members; but if every member would secure two new names, it would solve the problem. There is merit also in the suggestion of raising the dues. The report we get is well worth a great deal more than that, as the gentleman stated.

MR. THOMSON: Has the American Fisheries Society a committee on education?

MR. GRAHAM: A committee on publicity was appointed at St. Louis last year. Mr. Meehan made himself chairman, but I do not think he has done anything about it. There has been practically nothing done, except what some of the other members of the committee did themselves, and that has not amounted to very much. I believe that a permanent committee on membership and publicity should be appointed, and I believe that committee should be required to make a report at every meeting.

PRESIDENT: I think the suggestion is a good one; we cannot have too much publicity. The newspapers would be glad to give us space if we would give them something to write about. I shall be glad to appoint the committee.

MR. GRAHAM: Would it not be well to consider this matter when there is a larger attendance? I would like to drop it until tomorrow.

Adjournment then taken until 9.30 next morning.

Wednesday, September 4, 1912, 10.00 a.m.

Meeting called to order at the same place by the President.

A paper on "Black-spotted Mountain Trout," by Mr. S. E. Land, of Colorado, was then read and discussed.

Dr. Palmer then read a paper by Mr. C. H. Wilson, of New York, on "The Whitefish—Minimum Size Limits—The Scales vs. The Yard Stick."

REPORT OF EXECUTIVE COMMITTEE

PRESIDENT: We will now receive the report of the Executive Committee, of which Prof. H. B. Ward is chairman.

PROFESSOR WARD: Mr. President and Members of the Society: The Executive Committee appointed last year has made a serious effort to consider some of the problems before the Society. A meeting was held at the close of the session in St. Louis, and correspondence has been carried on so far as possible in the interval between that meeting and this. Some conclusions were then reached which it seems to me are worth your consideration and such action as may be deemed wise.

I might state informally that the report has not been presented to and signed by every member of the committee, but is made up of extracts from the correspondence. I had hoped that a majority of the committee would be present, but the members are scattered pretty widely. I believe the statements that I give will command the support of every member of the committee. I have omitted from this report statements which seem to be matters of discussion, and therefore questionable as a full report from the committee.

The committee would recommend that the Society offer to the libraries of the United States the option of taking out regular and continued subscriptions to the publications of this Society, on a basis of an annual payment of $1.50.

It would further recommend that all such libraries as engage to take our series of publications as issued be entitled to secure the copies of back publications still in the hands of the Secretary, at an expense of $1 each, provided five volumes be purchased at one time.

I might say by way of explanation that at the price of $1.50 we give the library a slight advantage over what one might call the outside membership price of $2 a year. At the same time we place those publications where they will be of great value to us in the way of advertisement, and also of value to the persons of all types who are interested in the study of fishery matters and in the reading of the papers which are presented before the organization.

It will be noticed, but it ought to be called definitely to your attention, that the offer to sell volumes at $1 each to a slight extent contradicts the ruling of the Society that the anniversary volume, which you remember was such a splendid thing, be not sold for less than $2; but if libraries will agree to take 5 copies, it seemed worth while to bait the hook a little for them, by giving them that fine anniversary volume at the regular price.

From the report of the Secretary we have, it appears, over 100 copies of 5 or 6 years of our later volumes, and 30 to 70 copies of a few others. They are now costing the Society storage, and they might be doing good missionary work. I happen to know from correspondence with libraries and from conversation with librarians, that as a rule the larger libraries of the country are ready to enter into subscription engagements with societies to take a series of publications like yours, which of course is the great national society and the only society representing this interest in the country.

The Executive Committee would further recommend that publications be not sent to members who are in arrears of dues, but that a communication be sent to such, indicating the willingness of the officers to supply the publication as soon as the arrearage is made good. I believe some members of the Society would be astonished to see to what extent we have sent our publications to those who have not reasonably—I believe I may say—considered their obligations. Some persons who have paid $2 or $4 have received publications costing the Society $10 or $12; and it is perhaps doubtful whether the Society ever gets the arrearage from those whose interest in the subject or in the organization at least seems to have declined.

The Executive Committee further recommends that a communication be sent by the new Executive Committee to all members in arrears, calling their attention to the fact that the Society is at present in need of the dues which they owe to the organization, and that it has come into its present condition by virtue of having printed and sent them valuable publications.

Many of these members have permitted their dues to remain unpaid through carelessness. In calling their attention in this fashion to the present needs of the Society, it may be hoped that some portion of the deficit which the Society has incurred may be made good in that way.

PRESIDENT: I am sure the Society will be pleased with this report which represents such careful consideration.

MR. THOMSON: I move the adoption of the report.

Motion seconded.

DR. T. S. PALMER, Washington, D. C.: May I ask Professor Ward whether the Executive Committee is prepared to furnish complete sets of the back volumes of the Transactions?

PROFESSOR WARD: Unfortunately not. The series is a very long one and the earlier volumes are entirely inaccessible. I believe Mr. Fearing is the only one who has a complete set.

MR. FEARING: Unfortunately I have not a complete set. The only complete set is in the library of the United States Bureau of Fisheries.

DR. PALMER: I had an experience with two different technical publications of this character. In one case we had a series of some twenty-odd volumes which there was no general demand for aside from a few specialists. In the other case we had a series of twenty-five or twenty-six volumes for which there was a more general demand. Of the larger series we prepared a very comprehensive index at considerable expense, somewhat to the consternation of our members who thought we were spending too much money on this index; but it immediately made available and made live capital of all the back dead stock, and with this index in the hands of libraries they immediately began to ask for a complete set. It was impossible to furnish complete sets, but we furnished sets lacking one or two volumes, of the other series, which was still more technical.

The Executive Committee was hard pressed for funds and tried the expedient of securing more members and contributions, but we found that the back volumes of the Society were after all very important capital. They went over the series with great care, fixed a separate price on every individual volume according to the stock on hand, made a figure for complete sets, or as near complete sets as they could furnish, then recommended a figure a little below the current figure for the common volume.

If I understand the committee, they are prepared to furnish back volumes at $1 each if five or more are taken. But the volumes are unequal in value, and I believe much more would be gained by setting a definite price on the last 10 or 15 volumes, and on certain volumes needed to complete sets; and after this index is in the hands of libraries, there will be a general call for certain volumes, or as complete sets as we can furnish; and if the index is issued promptly and is on the market on or before the time of this announcement, it will be possible to realize considerable income from the back volumes, if they are husbanded. If any of the members who have odd numbers will turn them over to the Society, there will be a very substantial sale for them.

The price of the publication I speak of is $3; we cut it to $1.50, and sold a number of sets at $75 each, because libraries wanted complete sets; and the index shows them that they must have the back numbers.

Mr. Fearing: The index that I am having prepared ought to be ready for the printer on December 1st. I think it would be a very good thing for the Society if reprints were made of the lacking volumes, omitting all extraneous matter bound in the earlier volumes, and simply reprinting the papers found in each index.

Dr. Charles H. Townsend, New York City: Most of the early numbers are very thin pamphlets. I think the suggestion of reprinting is a very good one. They could probably be printed in a single volume at small expense.

Mr. Fearing: For 26 years I have been trying to complete my set, and I was prepared to pay up to $25 for a single copy of the first volume. I know of only two copies of that issue; one is in the New York Public Library, which was part of Mr. Fred Mather's set, and the other in the hands of the United States Bureau of Fisheries. Mr. Livingston Stone's wife has written me that she thinks that somewhere Mr. Stone has a complete set, but they have not so far been able to find it. My own set is complete aside from the first volume.

Mr. Evans: I see by the Secretary's report that the 1910 proceedings cost $1200 for 700 copies. Is it right to sell them for $1?

Dr. Ward: I called attention to the fact that the rules of the Society provide that the 1910 issue is to be sold at $2, and that other copies are to be sold at $1. At the same time the committee felt, as it could offer no complete sets whatever, nor anything like a complete set, that it was necessary to bait the hook which was dropped into the library pool with a pretty delicate morsel—in other words, an opportunity of getting a $2 book for $1. I have here a list of the copies available. There are only 19 of the 50 volumes which can be had at all; one copy of 3; three of 5; five or six copies of 4 volumes; and then of six volumes there are 70 to 125. Practically, in other words, there are only 8 volumes that could be supplied to any extent—from 1904 to the present day. The other volumes are in the hands of the

Society in such small numbers that they play practically no part in the problem.

Dr. Palmer: I will offer the following amendment to the report:

1. That in lieu of the suggestion of the committee that 5 volumes be sold at $1 apiece, the committee be authorized to fix the price of individual volumes according to their scarcity.

2. That the committee be authorized to ascertain and report to the Society the probable cost of reprinting the earlier scarce volumes.

3. That the committee be authorized to obtain by purchase any of the latter numbers which may be needed or specially desirable.

4. That the committee be authorized to report to the Society a method of financing the publication of the index at an early date, because indexes are very expensive publications, costing more than twice that of ordinary matter.

In the case of the index I spoke of it was necessary for certain members to underwrite the project to the extent of a considerable sum, with the idea that later they would be repaid. This was done in order to insure early publication of the index. Indexing is usually one and one-half or double-priced matter; and it will cost something to get this index out.

Amendment seconded and unanimously carried.

Dr. Ward: I believe a motion is still pending on the report of the Executive Committee. We have just had an amendment to that motion. Was the reference to the Executive Committee, as I understood, or was it possibly to the Publication Committee?

Dr. Palmer: My amendment was to the report of the Executive Committee.

President: It is moved that the committee's report as amended be adopted.

Seconded and unanimously carried.

The Auditing Committee then presented a report on the Treasurer's account as follows:

This account, with vouchers accompanying, has been carefully examined and the same found correct.

Signed: HENRY B. WARD,
JAMES NEVIN,
ERNEST SCHAEFFLE,
Auditing Committee.

The report of the Auditing Committee was adopted.

Recess taken until 2 o'clock p.m.

Meeting called to order by the President at 2.30 p.m.

IRRIGATION DITCH SCREENS

MR. G. H. THOMSON, Estes Park, Colo.: I would like to have a committee of three appointed to investigate the merits of two forms of screens to prevent the loss of fish in irrigation ditches. If the Society can recommend the most desirable form, we can bring it before our legislature next winter in an attempt to secure an appropriation to protect our streams.

MR. S. E. LAND, Denver, Colo.: The screens are on exhibition out at Washington Park in readiness for inspection. I am in favor of a committee to examine them and report back to this body as to their use at the heads of our irrigation ditches.

I would not like to recommend anything that will place any great burden on the Society with reference to deciding upon which is the best screen; but if we see fit, let us resolve that we are in favor of some practical device that can eliminate or prevent the fish from going down the irrigating ditches and being destroyed. We can then take up the matter before the legislature and say that it is worthy of their consideration.

Now, if we can go before the legislature and say that a certain screen, according to the views of the American Fisheries Society, is practical, we can with fair prospects of success ask the legislature to appropriate enough money to buy a few and give them a thorough trial as to their practical value; also to see if the farmers will be willing to accept them. If it is a good thing we want it, but if it is not going to be accepted by the agricultural interests of this state or any other state like California, Idaho or Utah, then it will be a hard proposition, and we will not accomplish anything.

MR. SCHAEFFLE: We are very greatly interested in California in the screening of ditches, but I believe it would be unwise for any society such as this to recommend one screen or any one device to the exclusion of any other device. I think it is a matter of bad policy and very unsafe.

MR. FRANKLIN SPENCER, JR., Provo, Utah: I am interested financially in both of these screens, but I do not come to this meeting with any intention of having either screen recommended above the other. The question is, do the states that have irrigation want their streams screened so as not to obstruct the flow of water to the farmer, and at the same time keep the fish in the channels where they belong? I think it should be the concensus of opinion of this committee, if it is appointed, to recommend the use of a screen that will give the irrigator his water without obstructing the stream, and keep the fish in their proper channels. I believe either of the screens will do that.

Mr. Thomson moved that a committee of three be appointed to examine the screens on exhibition and report the style deemed best. Seconded by Mr. Spencer.

The vote was taken and apparently carried.

MR. EVANS: I call for a division.

MR. SCHAEFFLE: Is not the Society on record as being in favor of the installation of screens everywhere, where practical screens can be installed?

PRESIDENT: The Society is in favor of it, but when a motion is made and seconded the chair must put it.

Division was taken and the President declared the motion to be lost.

PRESIDENT: We have with us a gentleman we would like very much to hear from—Judge Beaman, of Denver, a man most of you know, if not personally, at least by reputation. He is one of the greatest fishermen in the west, a man who has fished longer than any one that I know of.

Judge Beaman then addressed the Society, pointing out particularly the fact that the automobile has become a very important factor in the depletion of fish and game.

The automobile is the friend of the hunter and the fisherman, but the worst enemy that ever came into the country of the game and the fish, and I have had considerable experience and observation as to that this year. I returned a few days ago from a 400-mile automobile trip. I fished in the Big Laramie, the North Platte and several of their tributaries in Colorado and Wyoming. It was a trip I never would have made without an automobile; I could not have made it by team, as it would have taken a month. I found on these big streams, wherever we stopped to fish, two or three automobiles with fishermen and hunters near us. With an auto a man can leave Denver in the morning and go 20 or 30 miles into the country, and have two or three hours' fishing and return the same day. If he goes up to one of our summer resorts, instead of having to fish within a mile or two of where he stops, he will with his automobile run up 20 miles in the morning to a tributary and come back at night. A man who made an automobile trip last week told me he had killed 60 sage chickens without leaving his automobile. That is, he shot from the road; he did not hunt at all; he had no dog.

While we were in Wyoming we met some Cheyenne men in an auto. They had strung across the front of their machine a big lot of fish. We passed on a couple of miles and found a sack of sage chickens which they had lost. We had them for supper.

I tell you that the auto is going to deplete our game and fish faster than anything we have ever had. I believe it is going to cause a depletion of fifty per cent or more in the next two years. But I do not know how you are going to avoid it.

Mr. Lydell informed the Society that Mr. Wm. P. Morton, of Providence, R. I., one of the oldest members, was ill at his hotel and unable to attend the meetings. Flowers were sent to Mr. Morton as a token of regard and of sympathy for his illness.

A paper on "Fishways," by Mr. W. O. Buck, of Neosho, Mo., was then read by the Acting Secretary and discussed.

At the request of Col. James A. Shinn, the President appointed a committee to arrange the toasts and programme for the banquet occurring the following evening. Dr. Ward, Dr. Palmer and Mr. Fearing were named on the committee.

A paper on "The Work of the Oregon Commission" was read by Mr. C. K. Cranston, of Pendleton, Ore. Discussion followed.

Recess taken until 8 o'clock p.m. same day.

Meeting called to order by the President at 8.15 p.m.

Dr. Field presented an address on the subject of "Water Pollution," which was discussed.

Adjournment then taken until 9.30 a.m. next day.

Thursday, September 5, 1912, 10 a.m.

Meeting called to order at same place by the President.

President: I would like to hear from any standing committee before we go to any other part of our business.

ELECTION OF OFFICERS

Mr. Seymour Bower: The Committee on Nominations is ready to report at any time.

President: We will hear the report of the Committee on Nominations.

Mr. Bower: I will say in behalf of the committee that to a great extent we followed usage and precedent, so far as re-elections and promotions are concerned. We also, of course, took into consideration the geographical situation, as nearly as we could, and last, but not least, the usefulness to this Society and fish culture generally, past, present and prospective, of the gentlemen named. After considering these qualifications and taking into consideration the other points mentioned, we recommend the following names:

President: Dr. Charles H. Townsend, New York.

Vice-President: Dr. Henry B. Ward, Illinois.

Recording Secretary: Mr. Ward T. Bower, Washington, D. C.

Assistant Recording Secretary: Miss Ethel M. Smith, Washington, D. C.

Corresponding Secretary: Dr. H. M. Smith, Washington, D. C.

Treasurer: Mr. C. W. Willard, Rhode Island.

Vice-Presidents of Divisions:

Division of Fish Culture: Mr. James Nevin, Wisconsin.

Aquatic Biology: Prof. L. L. Dyche, Kansas.

Commercial Fishing: Mr. W. J. Hunsaker, Michigan.

Angling: Mr. H. Wheeler Perce, Illinois.

Protection and Legislation: Dr. T. S. Palmer, Washington, D. C.

Executive Committee: Mr. D. B. Fearing, Chairman, Rhode Island; Mr. N. R. Buller, Pennsylvania; Mr. Ernest Schaeffle, California; Mr. J. Q. Ward, Kentucky; Mr. Dwight Lydell, Michigan; Mr. G. W. Miles, Indiana; Mr. George H. Graham, Massachusetts.

All of which is respectfully submitted by the Committee on Nominations.

Mr. Willard called attention to the fact that Dr. Smith and Miss Smith would be unable to serve.

The report of the committee was adopted unanimously, with the omission of the names of Dr. Smith and Miss Smith.

Subsequently, Dr. George W. Field, of Massachusetts, was unanimously elected Corresponding Secretary.

PRESIDENT: We would like to hear from Dr. Townsend, our new President.

REMARKS OF PRESIDENT-ELECT

Dr. Townsend: Fellow members, I had the misfortune yesterday to lose part of my voice; I wish I had it all, so that I could express my appreciation of the privilege of being made President of this Society. It is a Society with an ancient and honorable record. I have only been a member of it for a dozen years; there are men still living whb have been members three times as long. The Society has done a good work, and the history of the Society will be practically a history of fish culture in this county, and to a large extent the development of fishery industries in this country.

The Society has published very creditable proceedings for many years. I should only place these documents second to the voluminous reports and bulletins of the United States Bureau of Fisheries. But even in the publications of the Government I claim credit for this Society, because many of the most important contributions to Government publications have been made by members of this Society, while they were in Government service, and some of them have been in Government service for many years.

I was very glad to hear the Publication Committee discussing the matter of doing even more with our publications. I was greatly pleased last year when I learned that Mr. Fearing was having a full index of our publications made. This will be of great value.

Now, as the head of a very large museum devoted to aquatic life which has a laboratory, I have a great deal to do in pointing out to people who are looking for information, the sources of information on fish culture, fisheries, and ichthyology. I use the publications of the Government a great deal; I use to some extent the publications of the states, though not generally voluminous, and I use the publications of the American Fisheries Society a great deal.

I hope that we will succeed in getting our publications in the public libraries, where people can have access to them just as they can to the publications of the Government. Of course, the Government publications are issued in large editions, and are distributed first of all to libraries. The publications of the Government constitute a great encyclopedia of American fishery matters and are absolutely indispensable; and next to that come our own publications.

We really ought to republish our earlier volumes, so that we may have complete sets in our principal libraries. When the new aquarium in New York is dedicated, two or three years from now, I hope we can help to celebrate the occasion with a great meeting of the American Fisheries Society. Perhaps at that time I can offer you a home for a library of this Society. I do not really know how much of a library we have, but no doubt the Secretaries of the Society have publications that belong to this Society and that are of value and should be gathered together somewhere.

In conclusion, I will venture to speak for those who have been elected to the offices of the Society along with myself, and state that it will be our greatest pleasure to do the best we can for the coming meeting of this Society. (Great applause.)

PLACE OF NEXT MEETING

PRESIDENT: Is the Committee on Time and Place of Meeting ready to report?

DR. FIELD: Your committee has considered the matter of time and place of meeting very carefully. The Society had been canvassed, and we feel that there is a very strong sentiment in favor of Boston for the next place of meeting. The reasons which have led to this conclusion are somewhat as follows: There has just been opened this year an aquarium in Boston in which I am sure all the members will be interested; next year will be built, probably, the largest fish market in North America, and possibly in the world in which it is hoped to introduce the most modern methods of handling fish. This also will be of very special interest.

In addition to that, as you know, at Boston there is now being developed a new method in America of catching fish—the beam-trawl method. The members will have a chance to inspect perhaps together on a trip on one of the trawlers, this method of catching fish.

We are doing an increased amount of work in the propagation of trout and bass and other fish in Massachusetts. All this, I say, is in addition to the fact that the state officials, the Governor of the commonwealth, the Mayor of Boston, and others will be actively interested in everything which this Society may do.

We received a most cordial invitation from the State of Indiana, through the Board of Trade of Indianapolis, which we considered very carefully. In the selection of Boston we have, in accordance with custom, considered the future distribution of meetings, to meet the needs, so far as possible of all the members. So far as we have worked the problem out we are simply making suggestions. While we are making a definite recommendation for Boston, we are suggesting that the next meeting be held in the Mississippi Valley, and the following year at San Francisco, in connection with the 1915 exposition; all of which we incorporate in the report.

Motion made and seconded that the report be adopted.

After considerable discussion as to the advisability of committing the Society with regard to meetings so far in the future, Mr. Bower moved as an amendment that the report be adopted with the exception of the reference to the 1914 meeting being held in the Mississippi Valley.

Motion seconded and unanimously carried adopting the report as amended.

Mr. Schaeffle presented invitations from officers of the Panama-Pacific Exposition for the Society to hold its 1915 meeting in San Francisco.

A formal invitation was received to hold the 1913 meeting at Indianapolis.

TIME OF NEXT MEETING

Mr. Graham then inquired if the time was to be set for the next meeting. After some discussion it was decided to leave the matter to the incoming Executive Committee.

The President then read a telegram from Mr. George M. Bowers, United States Commissioner of Fisheries, Washington, D. C., conveying his best wishes for the success of the meeting of the American Fisheries Society and expressing his deep regrets at not being present.

Dr. Townsend then delivered an address on "Legislation Regarding the Seal Fisheries of the Pribilof Islands," which was discussed.

A paper on "The Catfish as a Host for Fresh-water Mussels," by Mr. A. D. Howard, Biological Station, Fairport, Iowa, was read by Dr. R. E. Coker, and discussed.

Dr. R. E. Coker, Director Biological Station, Fairport, Iowa, then gave a Demonstration of Free Pearls and Their Forced Production.

Mr. W. O. Hart, of New Orleans, then gave an address on "The Fish and Oyster Industry of Louisiana," which was discussed.

Mr. H. D. Dean, of Montana, then gave an address on the Grayling, which was discussed.

Recess then taken until 2.30 p.m., same day.

Meeting called to order by the President at 2.30 p.m.

A paper was then presented by Dr. Henry B. Ward, of Illinois, on the subject, "The Preservation of Our Fish Fauna." Discussion followed.

The following papers were read by title:

"Publicity," by Mr. B. G. Merrill, Hinsdale, Ill.

"Federal Control over Fish in Boundary Waters," by Mr. Henry Hinrichs, Erie, Pa.

"Cestode Cysts in the Flesh of Marine Fish and Their Bearing on Food Values," by Dr. Edwin Linton, Washington, Pa.

"Failures of Fertilization," Anonymous.

"A List of the Fishes Found in the Salt and Fresh Water of the State of Louisiana," by Frank M. Miller, New Orleans, La.

PRESIDENT: We will now hear from the chairman of the Committee on Resolutions, Dr. Ward.

REPORT OF THE COMMITTEE ON RESOLUTIONS

DR. WARD: The committee has considered the resolution as to the length and weight of whitefish drafted by Mr. Wilson and read yesterday by Dr. Palmer at the conclusion of Mr. Wilson's paper. In view of the fact that different authorities, state and national, have different opinions in regard to this problem, it did not seem wise to propose that this Society at the present moment should put itself on record as favoring positively and exclusively any one method. Consequently no action was taken on the resolution.

The following resolutions have been approved by the committee:

Resolved, That the thanks of the American Fisheries Society are due in especial measure to Mr. S. F. Duyyen, President, and to the management of the Albany Hotel for the numerous courtesies shown, and particularly for the magnificent game banquet on the closing day of the session.

Resolved, That the Society owes to its retiring President, Mr. S. F. Fullerton, to its energetic and most efficient Secretary, Mr. Ward T. Bower, and to its devoted Treasurer, Mr. C. W. Willard, a debt of gratitude for unstinted service in its behalf.

Resolved, That the American Fisheries Society expresses its thanks to the Denver Convention League, the Mayor of Denver, and to the Hon. James A. Shinn, State Game and Fish Commissioner, for the splendid hospitalities extended to its members at this meeting.

Resolved, That a vote of thanks be tendered to the Hon. W. L. May and his associates on the local committee for their careful preparations which contributed so markedly to make this meeting a success.

Resolved, That the Society express its thanks to Mrs. Mary Pell and Dr. George W. Pell for the unique banquet tendered to visiting members on Wednesday evening.

Resolved, That the American Fisheries Society extends its warm thanks to Judge Beaman for his constant and successful efforts for the comfort and enjoyment of members.

Resolved, That the Society learns with regret that Dr. Hugh M. Smith finds it impossible to continue to serve as its Corresponding Secretary, and hereby tenders to him its sincere thanks for the time and attention he has devoted to the duties of this office, resulting in many valuable reports and contributions which are a part of the permanent records of this Society.

WHEREAS, the Congress of the United States has passed an act to give effect to the convention between the United States and Great Britain, Russia and Japan, having for its primary object the suppression of pelagic sealing, and

WHEREAS, this measure was amended so as to establish a five-year closed season on male seals on the Pribilof Islands, contrary to the advice of the United States Bureau of Fisheries and its advisory board, including the best informed scientists of the country, all personally familiar with the islands and the fur-seal problem, and contrary to the expressed opinion of others personally familiar with the conditions of seal life on the Pribilof Islands, now therefore be it

Resolved, That the American Fisheries Society places on record its deep regret, that Congress should have acted contrary to the advice of the recognized authority of this country in such matters, and be it further

Resolved, That this Society recommends the early repeal of this provision, which is contrary to all biological experience and which can lead only to dissatisfaction and the ultimate exploitation of the seal fishery by private interests, and with detriment to the herd, consequent financial loss to the Government, and loss of prestige to the nation.

WHEREAS, The fisheries of certain states are being unnecessarily depleted by unwise local regulations, and

WHEREAS, The shad and alewive fishery among others are of special importance (apart from their direct food value to man) by attracting to our coastal waters the more valuable predatory fish, and

WHEREAS, The alewive fisheries are frequently notoriously mismanaged by town and county officials, be it

Resolved, That this Society urges upon every citizen and every state the increasing importance of adequate development of these fisheries under competent national and state direction and authority.

WHEREAS, There has been brought to the notice of the American Fisheries Society, the deplorable depletion of streams by reason of the unprotected head-gates of irrigating ditches, *Resolved,* That we, The American Fisheries Society in convention assembled, do most earnestly recommend to the Fish Commissioners of the states where streams are drained of fish by such ditches, the urgent need of the enactment of laws for the protection of fish from said ditches; and be it further

Resolved, That we urge upon the Department of Commerce and Labor the protection of all head-gates to Government irrigation canals, now a great cause of draining our streams of fish.

WHEREAS, The rapid decrease in the fish supply of our waters threatens the ultimate extinction of many types of fish life which are of interest to the student and of importance in preserving the biological relations between aquatic organisms, and in giving future generations an idea of the wild life of American waters, and

WHEREAS, The utilization of stream waters for domestic and commercial purposes is growing so rapidly with the advancing population of the country and with the increasing development of natural resources as to indicate clearly the complete transformation of all water systems in the early future, unless definite measures be taken to provide for this contingency, therefore be it

Resolved, That the American Fisheries Society urges upon the proper authorities in the nation and in the various states the necessity of taking immediate action to set aside fish refuges or aquatic preserves in which the contamination of the water and any modification of natural conditions for aquatic existence shall be forever forbidden, and

Resolved, That these reservations be so located and distributed throughout the country as to provide for the preservation for future generations of representative tracts of water systems which naturally serve as breeding places and as living grounds for the various types of fish and other aquatic forms, and finally, be it further

Resolved, That the Chairman of the Executive Committee be instructed to send to the President of the United States, to the Governor of each state, and to the State Game and Fish Commissioner thereof, a copy of this resolution, with a letter calling attention to the importance of the matter and urging that careful and early consideration be given the problem and that definite action be taken to set aside and protect such fish reserves.

Motion made, seconded and unanimously carried adopting the report of the committee and adopting separately all resolutions recommended by the committee.

PRESIDENT: I want to thank the members of the American Fisheries Society for the courtesies extended to me as their presiding officer; I know that I have fallen far short of what I ought to have accomplished; but you bore with me and I appreciate it. I now declare this convention adjourned sine die.

COMPLIMENTARY DINNER

On Wednesday, September 4th, 9.30 p.m., Mr. George W. Pell, Jr., gave a dinner to the members of the American Fisheries Society at Pell's Fish and Oyster House, 520 Sixteenth St., Denver, Colo. Descriptions of various fish were given, and addresses made, all winding up with a dinner which lasted until midnight.

BANQUET

On the last day of the meeting, a banquet was given at the Albany Hotel. It was a great banquet. It was a feast without price, for the game wardens and the fishery society men alone, of all in the United States, could give such a dinner. And Colorado, with Col. James H. Shinn, State Game and Fish Commissioner, as host, could alone, of all states in the Union, furnish the viands that were served.

Colonel William Jennings Bryan was called upon to make a speech. He avoided politics. He spoke for the further conservation of the fish and game of the country, and said he would help as he could to that end. Later Mr. Bryan became a member of the organization whose guest he was.

"I have attended many banquets," said Mr. Bryan, "but here I feel like a fish out of water, I am out of my element."

"I have a speech for every ordinary occasion. I have the political speech, I am always ready with the graduation day speech. I know what to say to a Labor Day crowd, and I am at home at a farmers' picnic, at a Y. M. C. A. gathering, a women's seminary, but here I am stumped."

Mr. Bryan said he never had been a hunter. He said after he had finished a political campaign he was always looking for something that ran and hence big game did not appeal to him.

In conclusion the Democratic leader said he would work as best he could to preserve the game and bird life for future generations.

Judge D. C. Beaman was toastmaster at the unique feast. In introducing Colonel Bryan, he said there was an "open season" on presidents with the exception of the Bull Moose.

The service and cooking of the wild game by the Albany Hotel management was all that could be desired. Old hunters, who had been called back to other days by the food prepared for them, said that it tasted even better than before the campfires of the long ago.

The game and fish was provided by Colonel Shinn from animals that were set aside for natural history specimens, and hence no law was really broken in the giving of the dinner. "It was a great spread," said all who attended, "and we may never get another such chance."

Colonel Shinn welcomed the banqueters. Mr. Samuel F. Fullerton, President of the American Fisheries Society; District Forester Smith Riley, Mrs. Mary C. C. Bradford, Dr. T. S. Palmer, of the United States Biological Survey; Dr. Henry B. Ward, of the University of Illinois, and Mr. Daniel B. Fearing, of the Rhode Island Fish Commission, were the other speakers. Mr. George W. Pell assisted in the preparation of the dinner.

In Memoriam

RICHARD O. CHENEY

JAMES CRUICKSHANK

S. L. FRENCH

H. G. SAUNDERS

J. M. K. SOUTHWICK

LIVINGSTON STONE

PART II

PAPERS AND DISCUSSIONS

A DEFENSE OF THE HUMBLE DOGFISH

By George W. Miles

When the white man first came into the West, bringing with him the pride of his modern civilization, he found the lakes and streams swarming with splendid game fishes. Bass there were in such great numbers that, though they were of size and strength to make them respectable, the taking of them was hardly considered proper sport, its accomplishment was so easy. There were pike and pickerel of weights up to twenty pounds and more, and sometimes muskellunge still larger, to test his tackle and his skill, and these did he prefer to pursue, their capture being more in keeping with his estimate of his own dignity and prowess. All these were admitted to his table and proudly offered to his guests, not because of the superior excellence of their flavor (which was excellent indeed) but because of the vanity of the master of the household, whose sportsmanship was thus best exploited.

Bluegills, crappies, bullheads, perch and other humbler fishes were there also in these lakes and streams in countless numbers, created to be caught by the women and children (and probably intended to be eaten that their joy in the catching of them might not be marred), and these, too, were admitted to the table on ordinary occasions, always to the humbling of the pride of the master of the household, however, who never failed to apologize for the presence of them if a guest was at the board.

Now, as the early Hoosiers would have said, "betwixt and between" these was another fish in which the waters also abounded, and in which they abound even to this day, which, although its size would have entitled it to respect, was so utterly stupid that no man of the time with a drop of sportsman's blood in his veins could feel any pride in pursuing it, while, on account of its great strength, it was much in disfavor with the children, whose precious hooks and lines it innocently broke or made off with. And the fates had been unfair enough to give to it the name of dogfish, for no reason that any person could ever explain. And for the reasons I have given the dogfish was despised, and its flesh remained untasted.

For the reasons I have given, and still another reason. The Indians ate them! The Indians ate dogs, too—and there was the name! Ugh!

In truth, the Indians probably ate them for the very best reason in the world—that they are good to eat. But they made use of them almost to the exclusion of the other varieties I have mentioned, possibly not because they preferred them, but because they could secure them more easily than they could the others; for, you know, an Indian never fails to follow the lines of least resistance. I have told you of the dogfish's stupidity. He will bite at any sort of a bait, be it alive or dead, large or small, and get himself fastened on any kind of device; or he will lie still in shallow water until you slip a noose around his neck and pull him out. And so the Indians could get him easily, while it was difficult for them, being without fish hooks or spears or nets, as they were, to secure any other fish.

Did you ever see an Indian cook anything? If you did I warrant you had no stomach for food of that same kind for many a day thereafter while the memory of their culinary process remained acute. I cannot tell you how they cooked dogfish, and I would not if I could, for I want that it shall be forever forgotten, as I shall show you before I am through. But I have been told how they cook a dog—and so have you, I doubt not.

And so the poor dogfish, for no fault of his own, was placed under the ban as an outcast, despised by all members of society, and no person who had any care for his good name or reputation dared taste the flesh of one. There were a few, just one now and then, who defied the good opinion of their neighbors and ate of them, and every one of these always thereafter stoutly defended them as being of fine flavor, but his opinion was ignored as unworthy of attention. Children were taught at their mothers' knees that if they would keep their good names and hold honored places in society they must not eat dogfish! All men and women in Indiana and her neighboring states have grown up with this prejudice imbedded deep within them, so that if you ask any one of them if dogfish is good to eat *he* will rather question your sanity than answer you with a simple "No." And to ask a man if he ever tasted of the flesh of one is to insult him. Would he so far forget his place in life as to do such a disreputable thing! (But let me tell you in confidence—I know a lot of proud gentlemen who would be deeply wounded if you asked them such a question, who have feasted on dogfish and praised it most highly; but they did not know what kind of fish it was when they ate it. And I am not going to tell you who they are.)

Mr. William T. Hornaday, the director of the New York Zoological Park, has written a book on natural history, and he gives much interesting information about the dogfish. He says of it: "To naturalists, the Dogfish is a creature of much interest. Like the prong-horned antelope, it is so unique and peculiar that it has been necessary to create for it a grand division of classification which it occupies all alone. The antelope is only a Family, but this fish is a whole Order. Its other English names are Mudfish, Bowfin, Grindle and Lawyer; and since Linnæus christened it *Amia calva* in 1766, eleven other naturalists have given it eleven other names in Latin.

"The dogfish has an air-bladder that is divided into cells, and is a half-developed lung. At intervals it ascends to the surface of the water, gulps down a mouthful of air, just as a turtle does, and descends again. If hindered from rising when the time comes to take in a supply of fresh air, the fish struggles violently, like a mammal about to be drowned;

but it can expel air while below the surface. This character indicates that lungs were first developed in fishes, from modifications of their air-bladders." For all of which we thank Mr. Hornaday. But why should he leave off talking as a scientist, about things he knew very well, no doubt, to tell us, in an unscientific way, what he knew nothing at all about that: "save to the negroes of the South its flesh is quite unpalatable, and valueless as food"? Here is a case of false training in youth. For I will wager that Mr. Hornaday never tasted the flesh of a dogfish, unless he thought it was that of a catfish or pickerel. And if he ever did that, I will wager again that he declared the flavor of it to be splendid, just as many other good people have done when they were similarly deceived. Anyhow, we do not need a scientist to tell us whether the flesh of a fish has a good flavor, or whether it has not.

I never yet have known anybody, either a negro of the South, or a white man of the North, who has eaten of the flesh of a dogfish which has been properly dressed and cooked, but admitted the flavor of it to be as fine as that of a bass or of a pike, which latter it much resembles; though I have known of a great many epicurean people doing this who would not have eaten of it at all if they had known it was a dogfish. The only ones I have found who told me that dogfish are not good to eat have been those who never tasted of them.

Now, all the lakes and the streams of the Middle West abound in this beautiful fish, and if people made common use of them, as they ought to do, and as they do of bass, pike, catfish, sunfish, and perch, the flesh of none of which has any better flavor than has the flesh of the dogfish, the value of our waters as food producers would be greatly augmented.

Wherefore, let me beg of every person who has never eaten of dogfish (or who does not know it if he has), and who has always believed them to be unfit for food because about everybody else seemed to think they were, that he lay aside his prejudice long enough to give the matter at least one honest test.

Before you do this, however, I beg of you that you let me advise you carefully as to how the fish should be dressed and made ready for cooking, for I would have the test a fair one, otherwise the fish may be condemned on account of its not having been properly prepared and for no fault of its own. Not that any particular method is necessary for the preparation of this particular fish, but a dogfish is large and his body is round and thick, and if the dressing be not properly done, the pieces of its flesh will not be cooked through, and rare fish of any kind is an abomination.

Many people have told me that they liked small bass but not large ones, which they asserted tasted "mossy." I know that the large bass was improperly dressed, otherwise, with similar cooking, its flavor would have been exactly the same as that of the smaller one. Others have said that they disliked pickerel or pike. There is no finer fish in any of our waters than these. They are just about as good as dogfish. But the bodies of them are also round and thick, and they can not be properly cooked if the skins be left on them and the "backbones" be left inside them. And the same thing is true of all large fish, including carp, which, when properly prepared, are very, very much better fish than you have ever given them credit for being.

But to return to our dogfish: First take the skin off him. It is thick and tough and his flesh can not be well cooked through it. You can do it more easily than you can take off his scales, in the following manner:

With a sharp pocket knife rip his hide down the belly and back, from the head to the tail. Now tack his tail fast to a board, cut the skin around the tail and start it with your knife until you can grasp it with a pair of pincers; then pull steadily, following along and parting the skin from the flesh lightly with the knife, as though you were skinning a muskrat, or other fur-bearing animal. Draw the nails, turn the fish over, and repeat the process on the other side. Now cut off the head and tail and remove the entrails. The body of the fish, solid and firm and of a reddish color, much like that of a bullhead catfish, will appear appetizing to you. Next lay it down on the board, belly uppermost, and with your knife separate the ribs from the "backbone," cut the flesh free from this bone and take it entirely out. You will now have all the valuable flesh of the fish in two slabs which, when washed and cut into pieces of the proper size, will be ready for the frying pan.

In this frying pan have fat enough that these pieces will almost float, and fry them much as you would doughnuts. Have it good and hot when the pieces, first coated with flour or cornmeal, are dropped into it, and keep it thus until they are fried nearly as brown as doughnuts. Then with a fork lift them up, allowing the hot fat to drain from them, and serve.

I have advised the skinning of a dogfish from the tail toward the head, because the skin of it, which adheres rather tenaciously to the flesh, is more easily removed that way than if pulled from the head downward. The same is true of a pike or a pickerel, on which the skin also sticks hard to the flesh. Neither of these fish should ever be cooked with the skin on it. Bass, crappies, bluegills, sunfish, and perch may be skinned easily, and the flavor of every one of them will be vastly improved if it be skinned before it is cooked. But whether it be skinned or not, any fish weighing more than a pound should have the backbone removed from it before being fried.

Now I beg of you that you put away the old prejudice that you have carried with you all your years without reason. Give the dogfish a fair and honest trial. If your verdict be that his flesh is not good, I will abide by it; on the other hand, should you agree with me that it should be eaten, much value will be added to our lakes and streams, for he is easily propagated, and, notwithstanding the wantonness with which he has been sought out for destruction, his numbers are legion in all the waters of the West.

DISCUSSION

PROF. L. L. DYCHE, Pratt, Kan.: Is that the same species of dogfish that is found in Lake Michigan?

MR. MILES: Yes.

PROFESSOR DYCHE: In 1895 I caught dogfish at Charlevoix, Mich., cooked and ate them, and found them much like catfish. I have also eaten dogfish cooked by Indians.

MR. W. H. HUGHES, St. Louis: You think they do not interfere with the stream or the growth of the game fish?

MR. MILES: No, they are a benefit to them. The dogfish is quite prolific.

MR. DWIGHT LYDELL, Comstock Park, Mich.: I had not expected to tell of my experiences in eating dogfish. I was not going to say anything about it until Professor Ward came in, and I knew I had a witness to verify my statements.

We ate them at Charlevoix. While we were studying the habits of the whitefish we experimented eating everything that the lake would produce, even to lawyers and mud-puppies. When people begin to eat dogfish, I am ready to eat most anything.

PRESIDENT: I am sure that the Society knows dogfish are not harmful, after they have looked at the two splendid specimens of physical manhood who admit experimenting with them.

MR. W. E. MUSGROVE, Leadville, Colo.: What do dogfish eat? Do they eat the same food that the game fish subsist on?

MR. MILES: Altogether.

MR. MUSGROVE: Then we don't want them.

MR. MILES: Nature keeps up a nice balance in these matters. We have garfish, big pickerel, pike and dogfish all dwelling together in harmony.

MR. MUSGROVE: But one lives at the expense of the other.

MR. MILES: But remember that the young dogfish are excellent food for bass and other game fish. I am commissioned by the Commercial Club, of Indianapolis, to induce this Society to meet at Indianapolis next year, and if you do we shall offer you a dogfish dinner at one of the hotels, and ask you to pass judgment on it without prejudice.

MR. D. C. BEAMAN, Denver: I move that the discussion of the dogfish matter be laid on the table until next meeting.

MR. SEYMOUR BOWER, Detroit, Mich.: I have never eaten the dogfish, but I think Mr. Miles is correct when he says they are wholesome food. A number of years ago I was employed at the Put-in Bay hatchery of the Bureau of Fisheries. Mr. Stranahan, the superintendent, claimed that every species of animal, land or water, is suitable for food. Some, of course, are not as toothsome as others, but all are wholesome, more or less palatable, and nutritious to some degree. When fishing through the ice we caught a good many mud puppies, commonly known as "water-lizards." They are quite numerous in the shoal waters of Lake Erie, and certainly very repulsive in appearance. At first I did not dare take them off the hook with my hands, but I soon got over that. One day Mr. Stranahan said: "I am going to eat one of these mud puppies." He wanted me to join him. My prejudices would not allow me to do so, but he dressed one, put it on a shovel, took it to the furnace in the engine room, cooked it over the coals, brought it into the office, salted and peppered it, ate it with a great deal of evident relish, and said it was just as good as whitefish. I can testify that it looked as good, smelled as good, and that the flesh was white, firm and flaky and apparently all right. He prophesied that some day it would be considered a great delicacy and sought for the same as turtles and frogs, which were once tabooed, just as the Menobranchus is today—the mud puppy.

There is no good reason why the dogfish should not be eaten; but I believe that, in view of the rapidly increasing price of fish and the fact that a great many fish within the memory of nearly all of us which were not marketable at all, are now bringing a good price, the day is not far distant when the dogfish will find ready market at a fair price.

Mr. C. K. Cranston, Pendleton, Ore.: I never saw a dogfish, and do not know what they look like; but I want to ask Mr. Miles if it is not possible that the food upon which the dogfish may have subsisted may not have had something to do with its flavor. As a reason for asking this question I want to say—and I think you will all agree with me—that the rainbow trout is a very fine fish, but it may surprise you to hear me say that I have tasted rainbow trout that were not fit to eat; and that I attributed it to the fact that the ones that were not eatable were those that had subsisted on the wrong sort of food. It may be possible that the dogfish which were first pronounced of bad quality had fed on bad food. I have eaten rainbow trout of all degrees of excellence from, I suppose, the best fish that the Lord ever made, down to those that, when taken in the mouth, were so unpalatable that you would have to spit them out.

Mr. Miles: I have known them to be thrown back, when fish were plentiful; but the dogfish is as beautiful as the bass or the trout; there is nothing unsightly about him, and he lives on the same food as the bass.

Prof. H. B. Ward, Urbana, Ill.: As this seems to be an experience meeting, I might say a word with reference to the subject matter of the discussion. Give an animal a bad name and hang it. Really the name dogfish is not properly applied to the fish in question. As those who are familiar with salt water fish know, the dog fish proper is a type of small shark; and this inland water fish ought to be called the bow-fin, or some other suitable name, because it has absolutely no relationship or likeness what ever to the marine dogfish.

There is no reason why a bow-fin should not be perfectly good to eat, and there has been sufficient testimony on that point, I believe; yet I confirm all that has been said in regard to it.

I want to add one word also with reference to the mud puppy, so-called, which is another instance of an animal being condemned on account of its name, or possibly on account of its looks. It is a first cousin to the frog, and there are some of us who occasionally pay a good price to get fried frog legs; yet the meat of the so-called mud puppy or the *Menobranchus,* is the same as the meat of the frog; it is really a more solid meat; and if there are any here who enjoy frogs' legs they can get a larger quantity of the same meat at a much cheaper price by buying the animal which has been condemned under the evil name of "mud puppy."

Both the fresh water dogfish, or bow-fin, and the mud puppy are good livers, and are entitled to be added to the list of delicacies which the human race enjoys.

It is quite appropriate that this Society should extend the list of table fish, for with the disappearance of some of the kinds to which we have been wedded in the past, there is need for something which will be within reach of the pocketbook. Now, the bow-fin and the mud puppy will actually take the place of any high grade fish, and of frogs' legs. Therefore, those who are here can with great safety propagate the gospel of these new delicacies, and they will find that when they add them to the menu, if they will simply change the unsavory names, people will think they have one of the greatest delicacies of the season.

PRESIDENT: Through this dogfish discussion we may have found out something of great value.

THE GAR PROBLEM

By E. E. Caldwell

Of all the enemies of the fishes indigenous to the waters of Illinois, the gar, *Lepisosteus osseus,* is at the head of the list, not only as a voracious consumer of other fishes, but also as a destroyer of the food used by the game fishes.

Forbes and Richardson, in their book, "The Fishes of Illinois," have this to say of this greatest pest we have in the waters of the state:

"This voracious, active, and well-protected fish is a notable winner in the long struggle for existence which its species has maintained, but it is a wholly worthless and destructive nuisance in its relations to mankind. It is the enemy of practically all the other fishes in our waters, and so far as it eats anything but fishes, it subtracts from the food supply of the more valuable kinds. It has, in fact, all the vices and none of the virtues of a predacious fish. On the other hand, it is preyed upon by nothing that swims, and is so well adapted to the varied features and vicissitudes of its habitat that it is proof against any but the most extraordinary occurrences.

"From its long cylindrical shape and its activity when alarmed, it is not as likely to be held by the fishermen's nets as most other fishes of its weight, and it consequently survives on our fishing grounds in very disproportionate numbers, and diminishes their average productiveness in no small degree.

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"The gar is a voracious feeder and is especially destructive to minnows and the young of other fishes. The stomachs of specimens examined by Dr. Dean contained nothing but small soft-rayed fishes, less than 3½ inches long. Eleven small minnows were taken from the stomach of one male 24 inches long, and 16 from the stomach and pharynx of another 27 inches long. * * * Sixteen minute minnows have been taken by us from the stomach of a single specimen 2 inches long, * * * The abundance and destructiveness of gars in particular localities have recently led to serious efforts at extermination and pound-nets have been found quite useful for this purpose. * * *

"Their earliest food is apparently *Entomostraca,* but they begin at a surprisingly early age their life work of keeping down the fish population of the waters they inhabit. A specimen only an inch and a quarter long, examined by us, had taken a minute fish, and another two inches long and only an eighth of an inch in depth had filled itself with no fewer than sixteen very young minnows."

A volume of text would not give a better idea of the destructive and worthless nature of this pest. The State Fish Commission of this state has taken up the work of the destruction of the gar in portions of the waters of the state, so far as the limited amount of money at its command would permit. A law enacted by the Forty-fifth General Assembly made it the duty of commercial fishermen to kill and bury or burn all gars taken in their nets and seines, with a penalty for failure to do so, but its observance was the exception rather than the rule. A few who recognized its value as applied to their business in the future did destroy them, but the larger number, in their haste to secure the fish they wanted, simply threw them toward the shore and let it go at that.

So great has been the loss in the young of other fishes, that the Commission decided on making a warfare against the gar the principal part of its work, since the legislature had refused to make an appropriation for the usual work, the collection and distribution of our native fishes, so we have used the steamboat and crew, together with the seining gangs, in this work. We used the gill nets at the start, but found more practical results were to be obtained by the use of a small meshed seine, made of heavy twine. We have interested as many of the commercial fishermen as possible in the work, and, if it could be made general, the resulting reduction of the gars would be of immense benefit to their interests.

Very large hauls of gars have been noted late in the fall and early in winter when they congregate in certain parts of the rivers and are to a certain extent sluggish. One haul of several hundreds of thousands was noted. At the present writing the rivers fairly swarm with them, so plentiful are they that in passing over them with a boat, the oars hit them at almost every stroke. To go about the work of extermination successfully would take more money than we have at our disposal, but what we have is being used in that way. So far this season we have taken half a million or more, and hope to increase that number by many times before the season is over. I believe that if this work could become general all over the state, it would be the means of greatly increasing the supply of food fishes and their food. In Lake Mantangas, which is controlled by the State Commission, we note a wonderful improvement following the attempt to destroy gars. Some of the specimens attain a large size, and their destructiveness is in proportion, while the small ones are equally busy, but with smaller fishes. With the small meshed seine we take the small gars in great numbers, and when we are so lucky, or *un*lucky, as to get a bunch of big ones in a haul, it is generally at the expense of the seine, as "they go right through it," according to the foreman of the seine gang.

We hope to get such legislation at the next session of our legislature as will enable us to prosecute the work systematically all along the line.

Perhaps an illustration of the destructive qualities of the gar would be not out of place. On August 8, 1912, a pond back of the reservation at La Grange Locks was reported to us as being very low, and the fish in danger of perishing and becoming a nuisance. We sent a gang there with small meshed seines to clean it out and put the fish into the river. The pond, made by the overflow of the river, covered during high water several acres, but was then drawn down so that only a small area was left, with the water only a few inches deep. We took from the pond 1500 gars, mostly large, and about the same number of adult food fishes, bass, catfish, carp, and crappie, but no small ones. A week later we cleaned out a large pond at a point below, taking a large number of adult fishes and thousands of small fry, such as shad, perch, catfish, minnows, etc., but no gars. At the mouth of every creek and stream flowing from an inland lake, these gars congregate, and the destruction to all small fish life is almost incalculable, and certain extermination of this small life follows when the receding waters leave gars with them. This seems to me to be a subject deserving the attention of all who are interested in the conservation of the native food fishes.

THE CATFISH AS A HOST FOR FRESH-WATER MUSSELS

By A. D. Howard

The rapid growth of the pearl-button industry, with its increasing demand for shells of the fresh-water mussel, has already made it evident that this natural resource is not unlimited and that even a practical extinction is possible. In recognition of this situation the U. S. Bureau of Fisheries has carried on for several years an extensive investigation of methods of artificial propagation.

The interesting relation of parasite to host between the Unionidæ and fishes has long been known. An examination of fishes caught at random plainly indicates that in nature the number of mussels successfully finding a host is comparatively small. Lefevre and Curtis* have demonstrated that in certain cases a single fish may by artificial means be induced to carry several thousand more mussels than it would under ordinary circumstances in nature. Thus large numbers of the young mussels which otherwise would sink to the bottom and die are carried through the most critical period in their life history. The method of infection is as follows:

Young mussels or glochidia produced to the number of many thousands by each female mussel, are taken from the gills of the latter and placed in a receptacle with the fish to be infected. The myriads of glochidia thus distributed in suspension through the water, passing constantly through the gills of the fish, become attached to the filaments of the gills or in some cases fasten externally upon the fins. As soon as they become attached there is a reaction of the tissues of the fish, in the nature of an hypertrophy of the ex-

*Lefevre, G., and Curtis, W. C.: 12 Studies on the Reproduction and Artificial Propagation of the Fresh-water Mussels. Bull. Bureau of Fisheries, Vol, 30, 1910.

ternal epithelium, which produces a cyst enveloping the glochidium. Under normal conditions the young mussel remains encysted long enough to pass through a metamorphosis after which it drops from the fish in a form closely approaching the adult.

A little experimentation shows that, taken a given species of mussel, all fish are not equally susceptible. Some do not readily receive the glochidia, others quickly shed them, while others die from excessive infection. Thus we have in certain instances what has been called an immunity at least to a given mussel species. Lefevre and Curtis find immune to the glochidium of Lampsilis such fishes as the German Carp, certain minnows and darters.

Acting upon the information obtained from such experiments the Bureau has carried on practical work in mussel propagation. Fish in large numbers are infected and released to spread the mussels in whatever waters they may reach. This work, however, has been limited to a few species of the Lampsilis group, chiefly *Lampsilis ligamentina* and *L. anadontoides*. With one possible exception none of the Quadrula group of mussels, including some of the most valuable commercial shells, had up to the time of the present investigation, been carried through the parasitic stage. Many experiments had been made on various species of fish and under varied conditions to determine a suitable method of propagation. The rarity of successful infections and other results would suggest that as in other cases of parasitism in the animal and vegetable kingdom each mussel may have its appropriate host or hosts restricted to a species of fish, a genus or a family as the case may be. Since the number of species of mussel for this locality is forty or more and the number of species of fairly common fish at least sixty, the problem of determining the appropriate host for each mussel is obviously quite complex. To determine the hosts for each species of mussel by artificial infection, a "trial and error" method would be very difficult.

Obviously a more direct solution of the problem would be secured by a study of natural infections, i. e., fish taken at large are examined for glochidia and when present these are determined as to species, condition, etc.

In an investigation of some members of the Quadrula group of mussels which I have carried on this spring and summer the above method was employed. I made examinations of as many species of local fish as were obtainable, identifying as far as possible such glochidia as were found. Some glochidia, because of peculiarities of form or size, were readily determined, while others were less easily identified because of less apparent differences. In this study I found of great assistance the excellent preparations and drawings of glochidia by Messrs. T. Surber and H. W. Clark, of this station, who kindly placed their material at my disposal.

This line of investigation, as well as answering the main question for which it was undertaken, revealed some other interesting points. Among these may be mentioned the predilection of several species of mussel for one kind of fish; for example, "the Sheepshead," *Aplodinotus grunniens*, was found to carry commonly the glochidia of *Lampsilis lævissima, L. gracilis, L. alata, Plagiola donaciformis* and others. This fish feeds upon mussels and so we have an explanation of the presence of these thin shelled species upon its gills.

Another observation for these species, so far as I know previously reported for *L. lævissima* only was the extensive growth beyond the glochidial shell while still on the gills of the host.

Some cases of remarkably full infection have been found, but a small number seems more common for natural infection.

The absence of glochidia uniformly in certain species of fish is quite striking, as in the German carp, *Cyprinus carpio*, Linnæus, mentioned above, as well as the garpike, *Lepis-*

osteus osseus, Linnæus, and the dogfish, *Amia calva*, Linnæus. In some cases the immunity seems to extend to large groups of fishes as for example the Catostomidæ (suckers). The Catfishes have been regarded as belonging among the immune fishes, this opinion being based largely on the results of artificial infection experiments.

In my examination of catfish the results have been largely negative, especially in the spring catches, but on fish caught during July and August I found natural infection. The first of these on *Ictalurus punctatus,* the channel cat, and the second on *Leptops olivaris,* the flathead. The species proved to be *Quadrula pustulosa,* the pimple-back, a common shell of this locality and of considerable importance commercially.

To test for methods of "artificial propagation" I made infections with three species of catfish and two other kinds. The following were employed: *Ameiurus melas,* bullhead, *Leptops olivaris,* flathead and *Ictalurus punctatus,* fiddler. *Pomoxis annularis,* crappie and *Lepomis pallidus,* sunfish. When exposed to infection in the same tank and thus under the same conditions, the difference in susceptibility between the catfish and the other species was very marked and the difference in implantation still more so. The catfish retained the glochidia; while though abundant on the gills of the crappie and sunfish, they disappeared the second day. Experiments to determine the optimum infection were undertaken and a count of eight hundred made upon one fish. In this experiment the fish showed no discomfort nor any signs whatever of impaired vitality, however at the present time the optimum for the mussel has not been determined.

Later observation on natural infection in *Ictalurus punctatus* has yielded further confirmatory evidence that this species is the natural host for *Quadrula pustulosa.* The glochidia in these cases showed an advanced stage in the metamorphosis of the young mussels in which two adductor muscles are apparent and considerable growth beyond the glochidial shell. Eight out of eleven fish examined were infected and the maximum infection observed (on one fish) was twenty-one.

The results would seem to demonstrate *Ictalurus punctatus* as a natural host for *Quadrula pustulosa* and the experiments so far as they have gone would indicate that other species of catfish may be also. The possibilities offered by the catfish as a medium for artificial propagation are obviously almost ideal. This fish, valuable for food, is abundant and can be transported and handled with less mortality perhaps than any other species. These conditions make the expense of propagation less and the chances of successful distribution in every case greater.

Summarizing the practical results we find the investigation has provided a species of mussel and a species of fish not hitherto available for artificial propagation.

DISCUSSION

Dr. R. E. Coker, Fairport, Iowa: We at Fairport, Iowa, are engaged in the propagation of the freshwater mussels which support the important industry of button manufacture. The fishing has been so extensive as to deplete the more important rivers of the country, until the point is now reached where we have to replenish the beds. The method of doing so is this. We take the young stage of the mussel (the glochidium) and get that infected on the gills of the fishes; then, after a certain period of time, or right away, as the case may be, these fish are released in the streams, and the mussels in due course, after the necessary period of parasitism, fall to the bottom, where they can look after themselves. All fishes are not equally susceptible to the mussels; there are some which we cannot now use at all, but the game fishes can all be used to carry mussels of the *Lampsilis* group, and other species of economic importance. There is another group of mussels generally included under the genus *Quadrula* which yield a fine quality of button. Up to the present time we have not been able to do anything with that group of mussels. We now handle lots of others, but not those. Up to this time, also, we have had no use for the catfish, and a great many other of the coarse fishes. So when we seined out the overflow ponds and sloughs we could use the game fishes but had to discard the catfishes.

This paper by Dr. Howard shows some results of the work which he has been carrying on with reference to the quadrulas, mussels which we could not handle; and he finds that certain catfishes which we had no use for in mussel propagation are the hosts of one of these quadrula species. The *Ictalurus punctatus* is the natural host apparently of the *Quadrula pustulosa* or "warty back"—a useful shell. He has found young mussels on the gills of those fish and he has artificially infected the fish with these mussels, and they have carried them for a number of days. Just at this time he has not carried the matter far enough to know the optimum number, but he has one catfish now that is carrying 800. Of course the game fishes will carry from 1,000 to 2,000 more of the other species. Undoubtedly this catfish would have carried more if it had been loaded more heavily at the start.

Dr. Townsend: I have been greatly interested in the Fish Commission reports touching this subject. The dependence of the mussel upon the fish for its distribution is a very fascinating matter. I shall watch the progress of work out on the Mississippi with a great deal of interest.

I am at present writing a report on the new method of pearl shell cultivation on the west coast of Mexico. Last year I visited the great pearl fisheries at La Paz where a Mexican company has been cultivating pearl shell for two or three years. Entirely aside from the pearls that sometimes turn up in the pearl oysters, pearl shell is a very valuable commodity, being worth $300 or $400 a ton according to grade. There is no doubt that the company has greatly increased the supply of pearl shell in its locality, and while they refused to give me any information as to their methods, I was allowed to go over the place and form my own conclusions. I photographed the clusters of young oysters, the trays, the crates of shells sunk in the bay, the zigzag canal in which the crates are placed for the maturing of young, and altogether made two dozen photographs which will show what the method is. The promoters were harvesting the second crop of shells and appeared to have a great quantity.

The success of this work will be important to the ocean pearl shell fisheries of the entire world.

DEMONSTRATION OF DR. HERRICK'S FREE PEARLS OF FORCED PRODUCTION

INTRODUCED BY R. E. COKER

Dr. W. P. Herrick, of New York, has kindly authorized me to demonstrate to the Society a number of pearls produced as a result of artificial stimulation. These pearls, it should be stated at the outset, are not perfect, valuable jewels, but represent the successful achievement of a step, and that a highly significant one, in the solution of a most interesting problem.

For some years Dr. Herrick has been engaged in experiments with the view to determine if it were not possible to cause the production of free, perfect pearls as the result of artificial stimulation.

This work was begun with local species at Quissett, Cape Cod, and Woods Hole, Mass., where the common marine oyster, the hard clam, and a thin-shelled fresh-water mussel were easily available. At a little later stage, Dr. Herrick obtained some pearly fresh-water mussels of the Mississippi River through our station at Fairport; and, beginning with last year, 1911, a good deal of experimentation with fresh-water mussels has been done by him on the ground at Fairport. It may be added that, while we have not been able to extend him any important facilities, and his work has been conducted entirely with the aid of his own private resources, we have viewed the investigation with a great deal of interest.

There were, as he recognized, two stages to be accomplished: (1) to demonstrate by experimentation a practicable method of forcing the formation of free pearls, (2) to make the method applicable to the production of commercial pearls by the appropriate species. For accomplishment of the first stage (the determination of methods) the most common and easily procurable native species were used as mentioned—the common oyster, the hard clam or Quohaug, and a thin-shelled fresh-water form, *Anodonta implicata*—and this is the material which is available for your observation today.

The material is as follows:

(1) Specimens of the anterior adductor muscle of *Venus mercenaria* showing partially dissected free and complete pearls of forced production (1 year's growth).

(2) One of two living specimens recovered of our edible oyster, *Ostrea virginica,* showing free and complete pearl embedded in the anterior adductor muscle—induced by mechanical means.

(3) Several specimens of the anterior adductor muscle and one of the body of *Anodonta implicata* (from Quissett, Mass.) showing partially dissected free and complete pearls of forced production.

(4) Specimens of minute, round pearls and a "point" from *Venus mercenaria*—forced production, together with free, nacreous masses from body and muscle of *Anodonta implicata.*

(5) Two shells of the common edible oyster, one containing approximately round pearl, pearls formed in the adductor muscle and attached to the shell at the adductor impression. The pearl in each case is supposed to have been formed free and to have acquired a secondary attachment to the shell.

Dr. Herrick permits the following quotation from his letter:

"Several common and easily secured species were selected for experimentation that the comparative physiology might aid (1) in demonstrating a method of forced free and complete pearl production, (2) which might be applied to the production of commercial pearls by the appropriate species. Therefore, of these specimens some are from the marine species *Ostrea virginica* (our edible oyster) and *Venus mercenaria* (the hard-shelled clam), others from a fresh-water species, *Anodonta implicata*, abundant near by at Onset, Mass.

"You will recall an account of the beginnings of my endeavors given at the American Fisheries Society meeting of 1910, with specimens of the work then proceeding to produce pearl cysts, shown in discussing Professor Dean's announcement that Professor Nishikawa had discovered a method of forced pearl production.

"In the fall of 1911, unfortunately, only two of my marine specimens were recovered, only one of which had been treated to produce a free pearl; this, however, had a round pearl; and, of the fresh-water specimens examined, of four western specimens, one *Pleurobema æsopus* contained a button pearl, and four free, nacreous masses were obtained from nine specimens of *Anodonta implicata*. These latter were very irregular and some flake-like, and those of the marine specimen and *Pleurobema æsopus* might have been natural; so, though they established in my mind a belief that a method had been discovered, they did not seem worthy of presentation until it had been more definitely established.

"These specimens of 1912, however, about two dozen in number, show a definite, free and complete pearl, in the definite place treated, with such regular recurrence, that there would seem to be no good basis for a reasonable doubt of the demonstration of the method. Should there be any question, however, I would wish to have you treat the specimens in any way you see fit, by further dissection or section, decalcification of the pearls, or any other method, as others can readily be produced, but it is most desirable that the demonstration should be satisfactory. As regards the second proposition, viz., its application to the production of commercial pearls in the appropriate species, there yet remains much to be desired; as to species, increased certainty by more accurate technique, improved sphericity, fine lustre, and anatomical location giving better opportunity for larger and more perfect pearls. Therefore, though some work has already been done along these lines, its commercial applicability must be reserved for the results of present and later experiments, but I believe that a similar method may be further used on the Unionidæ, and possibly applied to certain species of the marine Margaritiferæ.

"It might be of interest in passing to note that, after diligent search and inquiry, I have been unable to find any further records of forced free pearl production with the exception of a record of the late Professor Nishikawa's announcement that he could force the production of free pearls, together with Professor Dean's announcement that he had heard of a demonstration given in Japan by Professor Nishikawa, in which he had certain pearl oysters opened, having predicted that a pearl would be found and that the pearl was found. But apparently no free pearls of forced production have ever come to this country from Japan.

"It would seem, therefore, that the present is as complete a demonstration as has ever been given and apparently the only one outside of Japan.

"It only remains then to express my hearty appreciation of the help and interest so many have shown."

THE FISH AND GAME LAWS OF OREGON

By C. K. Cranston

The enforcement of the laws pertaining to game, game fish and all classes of commercial fish, as well as the management of everything concerning these subjects, is within the control of a non-partisan and practically unsalaried board of five citizens, the law creating the board and delegating to it complete authority over the matters under its jurisdiction having been enacted by the 1911 session of the legislature. Prior to the enactment of this law, all matters pertaining to game laws and game were directed by a State Game Warden, an appointee of the Governor, to whom he was responsible, while all matters relating to commercial fish and fishing were under the direction of a Master Fish Warden, who held his appointment under a Board of Fish Commissioners, which consisted, ex-officio, of the Governor, Secretary of State, and the State Treasurer. The enforcement of the laws pertaining to game fishes was assumed to be jointly within the jurisdiction of the State Game Warden and the Master Fish Warden, but in practice it was largely under the direction of nobody. For a number of years controversies had constantly arisen as to jurisdiction in specific instances, with the result that the law enforcement was almost universally lax, and in many instances farcical.

The 1905 session of the legislature enacted a hunters' license law and the session of 1909 added to that an anglers' license law. The accumulation of the fees accruing therefrom formed a considerable fund, a large part of which was lying in the state treasury, unused, at the time the 1911 act went into effect, on account of the legislature having previously failed to make provisions for its expenditure.

This condition of affairs had created a feeling of dissatisfaction throughout the state, and game and game fish protection was consequently becoming more generally in contempt. The framers and supporters of the new law foresaw complete extermination of our game and game fish unless existing conditions were remedied, and for that reason advocated an entirely "new deal." The enactment of the 1911 law and the induction into control of the State Board of Fish and Game Commissioners was the result. The law creating the Board requires that four of the members shall be selected by the Governor, that no more than two of these shall belong to the same political party, and that two of them shall be residents of that part of the state lying east of the Cascade Mountains.

The persons chosen by the Governor to compose the four appointive members were Mr. J. Frank Hughes, of Gold Hill; Mr. C. F. Stone, of Klamath Falls; Mr. C. K. Cranston, of Pendleton, and Mr. M. J. Kinney, of Portland. In accordance with the law, these four met and selected a fifth member in the person of Mr. Geo. H. Kelly, of Portland. The Board then organized by the selection of Mr. Cranston as chairman and Mr. Hughes as secretary, and appointed Mr. R. E. Clanton as Master Fish Warden and Mr. William L. Finley as State Game Warden. Mr. Clanton was, and had been for about a year, the incumbent of the office to which he was reappointed. Mr. Finley had had extended experience as agent of the National Audubon Society in protection of bird life within this state but had never served as a state official, nor had he been specifically interested in strictly game regulations.

One of the first rules which the Board laid down to these chiefs and executives was that harmonious action between themselves is absolutely necessary and that on that class of work entirely depends their retention in office. They were given to understand that co-operation between the two departments is and must be a cardinal principle.

Thus organized, the Board has taken active hold of the work before it. The members have visited most of the state properties under the control of the Board. Formal sessions are held about every sixty days when all matters relating to the work over which it has jurisdiction are thoroughly discussed and orders given and resolutions passed as seems best.

The least radical changes have been made in the policy of the department toward the commercial fishing interests of the state. Most of the regulations which bear on this subject are governed by statute and are, therefore, not subject to any change by order of the Board. Increased energy has been brought to bear on the work of artificial propagation of commercial fishes. This work is directed, as it has been for a number of years by the Board of Fish Commissioners, toward increasing the stock of the several native species of salmon in the waters of the state. All the native species are propagated, but the chief effort is directed toward the keeping up of the stock of the chinook because this particular species is considered the most valuable of the native salmon. The Board is unanimous in the belief that it is wise to hold and nurse as great a number of young fish as possible to an age of from five to eight months before liberating them into free waters where they must shift for themselves and take their chances with numerous enemies and secure their own living. With the object of making better facilities for nursing the young fish to an age suitable for liberation, the several principal hatching stations are being improved by the construction of extensive nursing and rearing ponds. This work is under way at the Central Hatchery at Bonneville and at the Clatsop County Station on the Klaskanine River. Similar construction is begun and well under way at the station on the McKenzie River, as well as at the station on the Wallowa River, and it is intended to similarly equip all the stations in the state as fast as plans can be elaborated. In addition to the work of constructing rearing ponds, the facilities for storage and preparation of fish food are being improved as fast as practicable. At the Bonneville Hatchery a retort for cooking the food had been installed and a power wheel has been built for generation of electrical energy for lighting the place and furnishing power to grind the food. A cold storage room is also planned for keeping a reserve stock of food. Following the policy of its predecessors, the Board has used large quantities of smelt for feeding salmon fry and this past season forty-two tons were consumed. It has also gathered great numbers of eels which are taken wherever practicable but are mostly obtained at the falls of the Williamette River at Oregon City where, during the late spring and early summer, upwards of fifty tons were secured. Other kinds of food utilized are liver, milk curd, heads and other offal of the adult salmon packed at the canneries, and a wheat product known as "middlings," the latter being cooked thoroughly into mush.

From the spawn taken during the fall of 1911 and winter of 1912, the results obtained at the different hatcheries are shown by the following tabulated statement:

Station	Sockeye	Chinooks	Silversides	Steelheads	Total
Bonneville . . .	1,957,825	10,599,490	589,605	1,225,745*	14,372,665
Klaskanine . . .	....	2,522,500	377,655	....	2,900,155
McKenzie	....	75,000	....	....	75,000
Tillamook . . .	....	646,300	1,578,131	831,000*	3,055,431
Yaquina	....	148,992	1,554,602	7,145	1,710,739
Alsea	....	287,645	997,455	....	1,285,100
Suislaw	....	715,758	504,429	72,097	1,292,284
Umpqua	....	1,253,747	....	....	1,253,747
South Coos . . .	....	1,767,170	2,317,370	....	4,084,540
Coquille	....	221,740	1,672,850	....	1,894,590
	1,957,825	18,238,342	9,592,097	2,135,987	31,924,251

*Distributed as game fish.

As mentioned in the early part of this report, practically nothing had been done in the state toward the artificial propagation of native or non-native game fishes up to the time of the creation of the State Board of Fish and Game Commissioners. The judicious expenditure of the funds provided by the payment of anglers' licenses toward the protection and propagation of game fishes was believed by all the commissioners to be one of the chief duties which ought to claim the attention of the Board. After some discussion it was agreed that the first object to be attained was the selection of a location where a large supply of parent or brood fish of game species could be obtained and retained for propagating purposes at a minimum cost. A location in Klamath County on Spring Creek was selected and negotiations have been under way for more than a year in an effort to acquire for the state the necessary ground and water rights to enable a central game-fish egg-taking and hatching station to be established there. The land at this place is within the boundaries of the Klamath Indian Reservation, and up to date the Board has not been successful in its efforts to procure the necessary site. Pending the question of the Spring Creek location, it was not deemed wise to do more than prospect for and inspect other locations, and for that reason the results in actual propagation of game fishes by the Board for the first season of its work has not been what it was hoped it might be when first begun. Lacking a plant where wild fish could be captured in any great numbers for spawning and not deeming it wise to start the building of an extensive station for the maintenance of a large school of brood fish as long as there seemed a reasonable prospect of obtaining the site at Spring Creek, it has been forced to the makeshift of getting eggs for propagation work wherever they could be obtained, either by purchasing them from game fish stations in other states or by capturing the wild fish in limited numbers wherever possible. By these methods there have been produced game fish as shown by the following tabulated statement:

Station	Steelhead	Rainbow	Eastern Brook	Black Spotted	Total
Tillamook	3,767,000	....	....	4,150	3,771,150
Yaquina	14,000	....	....	131,100	145,100
Olive Lake	....	243,500	....	......	243,500
Strawberry Lake	....	32,500	....	202,000	234,500
Salmon River	493,000	....	....	......	493,000
McKenzie	....	195,465	....	......	195,465
U. S. Bureau of Fisheries	....	370,770	....	......	370,770
Colorado	....	103,600	....	......	103,600
Rhode Island	....	....	1,000,000	......	1,000,000
Yellowstone Park	....	....	....	625,000	625,000
Montana	....	306,000*	....	......	306,000
	4,274,000	1,251,835	1,000,000	962,250	7,488,085

*Eggs lost en route to Bonneville. No fry resulting therefrom.

The liberation of game-fish fry into the waters of the streams and lakes of the state has been under way during the summer of 1912. By the end of the season all the fry reared will have been released in as equitable a manner as possible with the means at our command.

One special feature in connection with the releasing of the trout fry worthy of mentioning is a contract made with Mr. S. S. Mohler, of Oregon City, who is familiar with the lakes of the Cascade Mountain region, to place in 75 or 100 of the lakes not now containing game fish in the neighborhood of 100,000 or 125,000 trout fry in the hope that these fish would breed naturally and ultimately stock the waters into which they were placed. For this purpose, this season, the eastern brook trout has been used. The contractor has used a train of pack animals for carrying the young fish beyond the limits of railway transportation. The contract price for this work was $1,500.00.

Following the example of its predecessors, the Board has directed the seining out of the sloughs and empounded leads of water along the lower Williamette and Columbia Rivers to clear them of useful fishes before these places dry up, with the lowering of the levels of the main streams, thus saving from waste large numbers of valuable fish that would otherwise die and be lost. The species thus conserved have been mostly bass, crappies and sunfish; all non-native fishes but nevertheless abundant in the waters into which they have been planted. The fish thus saved from destruction have been carried and released into waters where they may be free and many of them into ponds and reservoirs well adapted to their existence but not previously inhabited by any useful fish.

An active campaign has been instituted over the whole state for the enforcement of the law which requires that all obstructions in streams inhabited by migratory fish be provided with efficient fishways to enable the fish to pass up and down past the obstructions. Conditions in this regard are still far from satisfactory but much improvement has been brought about and it is the hope of the Board that in time every dam or natural fall will be provided with a fishway as nearly perfect as it is possible to have it.

The Board has given a great deal of consideration to the subject of irrigation ditches and canals and other forms of diverted stream channels, in their relation to fish life and fishing interests. Much waste of valuable fish is caused by the swimming down the course of these channels by all classes of fishes, but particularly young fry, and their ultimate destruction when they finally strand where the water spreads out over the land which it irrigates. The law, as it now stands in the statute, requires the screening of the channels of all diversions of natural streams to prevent the entrance of all kinds of fishes. It is found, however, that in practice any screen with meshes fine enough to turn small fry will soon clog with drift and silt and stop the flow of water into the ditch. The result is that it is utterly impossible to enforce the real spirit of the law. Many inventions have been made of contrivances, intended to screen ditches satisfactorily, which will be self-cleaning. The Board has examined a number of these but has not found any that appear entirely satisfactory. Most of them are efficient from the fish side of the question, but there are objections to all of them in their practicability as to installation and maintenance. Three different styles of automatic screens have been approved and recommended as satisfactory, in case they are installed and maintained, but none has been formally adopted and its use made compulsory. This is one of the most perplexing subjects with which the Board has had to deal and its solution in a manner which shall be equitable to both sides of the controversy, is one of the most greatly hoped for results which has come under our consideration.

The 1911 session of the legislature enacted a law which stops entirely the shooting of introduced pheasants for two years. The belief of the framers of this law, and of the Board also, is that by thus prohibiting the killing for a few years of these fine game birds, they will increase to such numbers that an open season may again be declared.

In order to help the natural breeding of game birds, particularly several species of introduced pheasants, the Board, early in its history gave consideration to the subject of the breeding in captivity and subsequent liberation of large numbers of game birds. In the fall of 1911, a contract was made with Gene M. Simpson for the leasing of his game farm in Benton county to the state, to be operated by the owner as a State Game Farm under the direction of the State Game Warden and the Board. Mr. Simpson's stock of birds was bought. His farm was leased and his services were contracted for for a term of three years. This game-breeding plant is now in full operation and will turn out this season 2,000 Chinese Pheasants, 200 Reeves Pheasants, 150 Golden Pheasants and 60 Silver Pheasants. Besides the work on the different species as indicated, experimental work is being conducted on native birds and other foreign kinds with a view of ascertaining the ability to breed in captivity many species and thus stimulate the production, by artificial aid, of many, if not all, the valuable game birds. The plans of the Board in connection with the liberation of game birds reared at the game farm is to liberate them in localities where they are now least abundant and where they can be assured of as good protection as possible against unlawful destruction. For this purpose, tracts are being secured in as many places as possible, of as large an area as practicable, which are being designated, marked and posted as game refuges. The game inhabitants of these tracts will be protected as carefully as possible with the idea that they will there increase and gradually spread beyond the boundaries of the protected area and ultimately stock the surrounding country to the benefit of the sportsman. Thirty-six contracts for the establishment of game refuge tracts have been made throughout the state, covering 12,402 acres, each tract having an area from 500 to 3,000 acres. Six other contracts are under consideration for a game refuge tract in Wallowa County, covering an area of approximately 1,500 acres.

Under the direction of the Board, the State Game Warden has entirely reorganized the Deputy Warden service throughout the state. The corps of deputies is divided into three classes, as follows: District Deputies, Regular Deputies and Special Deputies. The first named class are composed of the most active and efficient men and they are charged with supervision and, in some measure, control over the other Deputies within certain prescribed districts, in addition to the duties usually allotted to Deputy Game Wardens. These District Officers are paid a somewhat better salary than the regular Deputies, depending on the length of service and efficiency; their compensation averaging about $100.00 per month, besides the necessary traveling expenses. The Regular Deputies are paid a fixed salary in addition to actual traveling expenses, and are under the immediate direction of the District Deputies and of the State Game Warden. The Special Deputies are volunteer citizens, who are commissioned and supplied with a badge of authority but are not paid any regular compensation other than expense money on special cases. The compensation of the Regular Deputies varies with conditions, length of service and efficiency, but amounts to an average of about $70.00 per month besides necessary expenses.

The protection of the native so-called "big game" is under the immediate care of the corps of Deputy Game Wardens. No effort is being made by the Board to breed game mammals in captivity. One experiment, in conjunction with the Bureau of Biological Survey of the Federal Government, is being conducted with a view of determining the practicability of successfully transplanting wild wapiti or elk from one part of the nation to another. During the past winter, a herd of fifteen elk was accepted from the Federal authorities at St. Anthony, Idaho, which had been taken from the region in Wyoming known as Jackson's Hole, and was transported with considerable difficulty to the northeastern part of the state, where they were liberated, or rather placed in an enclosed area within a National Forest Reserve, the use of which was donated for this purpose by the National Forestry Service. It is too early to give results on this experiment, but a fair percentage of the animals survived the very trying ordeal of the long journey by rail, wagon and sled, and are now confined within the 2,500 acre pasture which is set aside for their grazing. Within the next year it will be known whether they will thrive and increase sufficiently to justify this and further efforts of the same nature.

The stock of "big game" animals of this state has been rapidly diminishing as the population has increased and civilization has spread over areas formerly held by primitive conditions. With a few exceptions, deer are more plentiful today in sections of certain eastern states than they are in the mountainous districts of Oregon. The Board believes that this condition is due to a number of causes, the chief of which is lax enforcement of poorly framed protective laws combined with the raids of predatory animals; and is unanimous in the belief that, if the illegal killing of deer, particularly of does, can be stopped, and the wolves, cougars, and wild cats exterminated, deer will naturally increase within the boundaries of Oregon, even with a reasonable open season annually for hunting them under proper restrictions. Towards the remedying of the first cause, the State Game Warden is putting forth his best endeavors. The state is so large, however, and the sentiment of the people towards game protection has become so perverted, that even with his best efforts far from a satisfactory state of affairs can be brought about. Under the direction of the Board, the State Game Warden is, through his deputies, conducting a campaign of education in an effort to create a sentiment favorable to game and bird protection and in opposition to what seems to be the prevailing sentiment amongst the populace.

For the elimination of the second cause, the Board looks to the next session of the legislature for relief. All authorities agree that predatory animals, particularly cougars and wolves, kill more deer annually in Oregon, by far, than all classes of men. The commissioners are firm in the belief that the state bounty for the killing of these animals should be made sufficiently large to induce systematic hunting of them to the point where they will become rare, if not extinct. It is argued that, if these bounties be made thus large, it will be an economy in the end, for, while it might cost a considerable sum at the beginning, it would be only a short time until there would be few, if any, animals left on which to pay bounties.

One of the duties laid down for the State Board of Fish and Game Commissioners by the Governor has been the suggestion to the next legislature of revisions and improvements in the laws of the state which relate to fish and game. The Governor has indicated in public utterances that this is expected of the Board; so, in obedience to that suggestion, this body is now actively engaged in the formulation of an entirely new code of fish and game laws, which it will present for the consideration of the 1913 session of the legislature with a view to its substitution for all existing laws now in force.

As indicated in the beginning of this report, the members of the State Board of Fish and Game Commissioners receive only nominal money compensation. Their salaries are fixed at five dollars each per day while actually in session, with a proviso that the annual compensation of each member shall not exceed one hundred dollars. The citizens who have undertaken this work cannot, therefore, be suspected of selfish motives. They are indeed actuated solely by a hope that they may by their efforts help to improve generally the conditions which relate to the game birds and mammals of the state and also the fishing, either for profit or sport, within the waters of the state. They know that the conservation of the game resources of the state may be made a mighty asset. The commercial fishing interest of the state has been, and still is, about the third in magnitude of all its productive industries. Faulty laws and inefficient enforcement of the laws have decreased this industry and threatened it with extinction. The Board hopes by its efforts to check the deterioration of this industry and, by stimulating artificial propagation, improve the supply of valuable food fishes naturally inhabiting the waters of the state.

Fishing for sport has long been recognized as one of the most pleasant forms of out-of-door recreation indulged in by mankind. The angling in the waters of Oregon has long been celebrated for its excellence. But the encroachments of civilization, combined with the lax enforcement of faulty laws, has caused a rapid deterioration in the angling conditions, and the devotees of angling were beginning to look forward to a time not far distant when the catching of real wild game fish within the boundaries of this state would be a thing of the past. The object and hope of the Board towards the sport of angling is that by vigorous stimulation of artificial propagation of game fishes, together with better and more honestly enforced protective laws, this sport may be improved and perpetuated and handed down to posterity even better than we found it in our boyhood.

DISCUSSION

Comment by Mr. Cranston during the reading of the paper: I have said that no stream after it has been obstructed will afford as good a passage for fish as before, and that all we can hope to do in overcoming the obstruction is to make as good a fishway as we can. But it is almost impossible that a stream once obstructed can be provided with a fishway that will be as good as if that obstruction had not been placed there.

Comment during the reading of the paper: The timber and lumber interests of Oregon are counted the first in the state in magnitude, agricultural second, and the commercial fishing interests third; so you can see that the fisheries are an important subject, and the judicious handling of them and the judicious enforcement of the laws regulating them are not boys' play in any way.

Further comment: I did not realize until I came here and heard something of the celebrity of Colorado, what a fine state we have in Oregon; and I want to say nothing derogatory to the people here. It opened my eyes to what we have at home. The fact that we have not advertised our angling resources is the only reason why we are not just as celebrated in that regard as some our sister states. It is not generally known and not widely advertised, but it is true that several streams in Oregon are probably as good as any in the world; and well-informed anglers come from the four corners of the world to angle in some of our streams, notably the Rogue, Williamson, Spring Creek and the Clackamas. The last-named stream was made celebrated through an article by Rudyard Kipling, who fished for steelheads there on the occasion of his first visit to Portland.

Mr. S. E. Land, Colorado: I am very much interested in the report of Mr. Cranston and especially in regard to fishways. We have had the same experience with our fishways in Colorado; but we have found that in a fashion they do allow the fish to ascend the river; and, moreover, the law is passed so that no man can fish within 200 feet of a fishway in this state during the season when the fish are running and spawning. That helps protect them. Otherwise there are only a few streams where they have been found to be of any advantage here in Colorado. But the law is insistent that they shall be placed on every obstruction in the water.

MR. CRANSTON: It might interest those present to know that we also have a law forbidding fishing within a limited distance of the outflow of the fishways.

PRESIDENT FULLERTON: Minnesota has it limited to 400 feet.

MR. CRANSTON: Our law stops angling within 200 feet and commercial fishing within 600 feet.

THE WHITEFISH

Minimum Size Limits. The Scales vs. the Yard Stick

By C. H. Wilson

The purpose of this paper is to obtain from the American Fisheries Society the endorsement of the best and safest method in the measurement of the whitefish of the Great Lakes that will give said fish at least one opportunity to reproduce its kind before being taken for the market or the table; such method to show both weight and length of fish to be taken; such endorsement to carry with it a recommendation to all states and provinces interested urging the adoption of the same. In this discussion of the whitefish the word is used as defined in the international treaty between the United States Government and Great Britain concerning fisheries in waters contiguous to the United States and the Dominion of Canada, which is as follows: "This term includes the Lake Superior or Labrador whitefish (Coregonus clupeiformis) and Lake Erie whitefish (Coregonus albus). It does not include the Menominee whitefish, called the Round Fish or Pilot Fish (Coregonus quadrilateralis)."

It is the firm belief of the writer that regulation by a minimum size limit of this fish is the most important of all present forms of protection to insure a generous supply of eggs for hatchery purposes, thereby largely increasing the present supply for commercial purposes. It is to be regretted that in all the valuable and helpful discussion of whitefish by our Society comparatively little in detail has been said about size limits. Certainly not as far as minimum size limits are concerned. In all instructive papers written in recent years on this valuable food fish little is found regarding protective size limits that would justify state or province in its acceptance of them in the formulation of regulations having in view a maximum amount of protection with a minimum amount of expense or hardship to the commercial fishery interests, and as before stated it is a source of regret for it seems to be the weak point in the armor of protection that has been thrown around this species through the efforts of the Society, its members and friends. This weakness in our armor has been discovered by the fishery interests, who prefer temporary advantage rather than permanent profits and successful efforts have already been made to break down former legislation which gave a fair degree of protection. Up to 1912, every state and province interested in the Great Lakes, save Pennsylvania, gave a minimum size limit of protection to the whitefish. Ohio's law is one and three-fourths pound in the round; Minnesota's, two and one-half pounds in the round, while the other states' and the Dominion's regulation is two pounds. This latter weight of a minimum size of two pounds has the endorsement of the heads of fisheries departments of both the United States and the Dominion of Canada, has the recommendation of the International Commission and was embodied in the treaty on international control of contiguous waters of the United States and Canada. When we of the states bordering upon the Great Lakes consider that, for twenty or more years, the United States Bureau of Fisheries has planted annually in those waters upwards of 200,000,000 of whitefish fry, the question is asked why these states should not legislate in harmony with the wishes of the Bureau of Fisheries, which are, as expressed by the Commissioner, that a uniform law of two pounds in the round for whitefish would be beneficial. Let us go back a moment to Pennsylvania. Notwithstanding that state has been accorded for years the privilege of taking and has taken millions of whitefish eggs from Canadian waters, and has received annually from the United States Bureau more whitefish eggs than any other state, some years more than all other states combined, one looks in vain in the Pennsylvania digest of fishery laws for even the word "whitefish," there being no direct protection by minimum size limit or close season during spawning season, the size of mesh of nets permitted in Lake Erie being the smallest known to be used for commercial fishing for fish other than trout in that lake.

Let us now turn to the Empire state, producing as it does only about ten per cent of the fish consumed within its borders, relying upon state and province for the balance of its requirements. Previous to 1909 there had been practically no restrictive legislation regarding size of gill nets to be used, close season or minimum size limit—an open season with unrestricted market. In 1909 legislation was secured in harmony with other states and provinces—close season during spawning season and minimum size limit of two pounds in the round. The old regulation regarding the size of mesh of gill nets to be used was not disturbed by statutory enactment, power being conferred with the commissioner to file with the Secretary of State an order increasing the size of mesh of nets to be used. This, however, was not done until two fishing seasons were passed, the order when filed not taking effect until January 1, 1911. One can readily see that commercial fishermen objected to a law that previous to 1911 permitted sale of licenses to use nets of such small mesh that the size limit of fish was violated; however, it must be said that the Lake Ontario fishermen endorsed the regulation and the Lake Erie fishermen said they did not wish to take immature fish under two pounds in weight. In 1912, there was a codification of the fish and game laws of the state; many hearings were given by the able committee on codification, the friends of the whitefish contending that the former regulation was fairly satisfactory to the people and not unjust to the commercial fishermen, confident that when a sufficient time had elapsed to show results, these regulations, ably assisted as we have been by state and national hatcheries would prove of great advantage in the rehabilitation of the whitefish industry in the state, asked for its retention in the new law, which was granted. The codification committee, its work well performed, presented a printed report to the conservation commission now having charge of the fish and game matters of the state. When this report was presented by the commission to the legislature for the purpose of legislative enactment it was discovered that politics, which has been so ably defined by a former president of the society, as a disease, had had its day in court, and that the cold-storage men, fish dealers, and their friends had gotten under the armor of the system of protection of the whitefish by the way of the size limit, for this bill displaced the former regulation and adopted a new method of measurement by making a minimum size limit of 12 inches, with no close season for whitefish for Lakes Erie or Ontario. This is the present regulation, and we are to consider this method of ascertaining size of maturity upon the precedent established that of a 12-inch size. The changing of the manner of determining the size of whitefish to be taken from a weight to a measure of length is indefensible. As is well known the common method of ascertaining size of the mature whitefish is a standard one endorsed by the various heads of fish and game departments of all states and provinces except as above stated. No state or province, the United States Bureau of Fisheries, or the fish culturists use any but a weight system of measurement, and the only records of importance to be found where the inch method has been used at all is in the handling of given specimens for purposes of scientific study and identification of species, none of which harmonize the 12-inch idea of protection with that of two pounds in the round. Further, in states and provinces outside of New York, which now assist in supplying our demands for the fish, the fishermen and the dealer is subjected to expense and inconvenience, entirely unnecessary, and places upon fish and game departments, who ship fish out of their own jurisdictions, the responsibility of legislating and enforcing regulations in harmony with New York statutes to protect their own interests, and in the last analysis provides a way of weakening the conservation of a once most valuable food asset. Under the second head of objections to change of method of measurements of whitefish, particularly of the 12-inch regulation, as embodied in the fish and game law of New York, our contention is that for the purposes of fish culture or propagating or increasing its supply such 12-inch fish would have no value, although the contention is made that a 12-inch fish might possibly spawn. This is not a protective measure, but a license to exterminate. Furthermore, as before stated, this proposed change of method of measurement of this fish has never been used by any state or province; neither is it recommended by any one as a safe or practical method of determining the proper size of a mature fish; neither has it the endorsement of one single fish culturist, having had or now having practical experience in the propagation of this species, either in state, national or provincial governments bordering on the Great Lakes; and the conclusion of many of these practical men, with whom the writer has had personal correspondence on this subject, is perhaps best stated by one of the superintendents of a United States hatchery, showing a large annual output of whitefish fry, who writes: "No one would think for a moment of taking a 12-inch whitefish for hatchery purposes." Thus are the statements of those who favored and proposed this regulation disproved. So also is the further statement that a 12-inch whitefish would weigh from one and three-quarters to two pounds disproved by actual specimens from Lake Erie, produced at the hearings before the Senate and Assembly committees on fish and game. Such exhibits show, as do governmental reports of these fish taken for scientific purposes, the utter fallacy of both contentions. The following are the measures and weights of fish shown in Albany, coupled with a fairly selected list from government reports, to which allusion has been made. Of the specimens of Lake Erie whitefish, shown at Albany, the smaller measured fifteen and one-quarter inches, weight one pound and nine ounces, while the larger measured sixteen and a quarter inches, weighing one pound, twelve and a half ounces. With the customary allowance of one-eighth for the shrinkage by evisceration, the smaller fish would weigh one pound twelve ounces, the larger one pound fifteen and a half ounces plus. The latter fish presumably was, when taken from the water, a fish of proper size to be taken under the law.

List of specimens in Washington, as shown by reports:

Name of Lake	Length	Pounds
Lake of Woods	21 in.	2½
Champlain	15 in.	1¼
Champlain	20 in.	2¼
Michigan	11⅝ in.	7 oz.
Erie	20⅜ in.	3¼
Michigan	14¼ in.	12 oz.
Michigan	14¼ in.	14 oz.

Herrings

Herrings from Lake Michigan, 13½ in. weighing 10 oz.; 13¼ in., weighing 13 oz.; 13½ in., 14 oz.

From Lake Ontario—12 in., 8 oz.; 14 in., 16 oz.

Lake Huron—11 in., 5 oz.

That the first appearance upon the spawning beds of the whitefish, according to Dr. Jordan, is not the best evidence of its maturity is strengthened by Government reports of females taken in Lakes Michigan and Huron from 1904 to 1911, inclusive. Females taken, 39,789; females stripped, 29,485; males taken, 75,821. There is no record of number of males treated or handled. Presumably not all rejected females were immature; however it is fair to assume that a large percentage were immature, thereby strengthening the opinion of many fish culturists that the statement of the late Frank N. Clark, that a mature fish should weigh two and a half pounds is a correct one. This same weight is the law for the State of Minnesota. Another very serious objection to the 12-inch provision is that furnished by a prominent member of the Society, viz.: that "as a commercial commodity such fish has not reached 50% of its potential value, and the taking of such fish must be a financial injury to the commercial fishermen. Furthermore, it is idle to presume that, under this system, no whitefish will be sold which, at the time of capture, was not of required length, said fish having undergone the inevitable change incident to transfer to market and cold storage operations. How, may I ask, will the sale of whitefish as herring (a less valuable product of the Great Lakes), under a 12-inch law, be prevented? Already this phase of commercial dealing has been a source of trouble in some states, it being almost impossible for the average man to distinguish between the two fish.

Under present conditions it is practically impossible for any state having a large population to furnish from the inside all food fish demanded by the people; and it should be easy to conclude that wisdom would dictate the necessity of not only protecting and conserving its own meagre supply, but throw around the incoming supply of fish the same protection accorded by the state or province from which they come that we with them may give stability to their own regulations and so continue their supply as well as our own.

The State of Pennsylvania does not in any way do this, and, of course, in New York, this is not what is being done under the 12-inch law. And when we remember that about one-tenth of the population of the United States are in New York, and that 90% of her supply of fish must come from the outside, do you wonder that we are disturbed with thoughts for the poor and those who for conscience's sake must purchase fish for food, and so come to you for assistance.

It has been stated that this 12-inch law on whitefish in New York is a license to exterminate.—Let me add, not only our own, but your own, and Canada's own, supply of food fish of this variety, for, if it has not already, it surely will become the dumping ground of the immature and illegally taken fish of your state and province, to the disgrace of the state and the jeopardy of the food fish supply of the continent; and this condition exists today, gentlemen, as a result of the insistence of politicians and the paid efforts of attorneys for the fish trust, cold-storage men and dealers, whose principles of doing business recognizes no delay in the taking of profits and brook no interference with their methods of conduct in business. Let us not deceive ourselves by believing that one point gained by these men opposed to the proper protection of fish life, as exhibited by legislative action in Pennsylvania and New York, will satisfy them, for it is here stoutly maintained that such successful breaking down of protective legislation will prove an encouragement to further encroachment upon laws protecting other varieties and in other states, thereby proving a menace to all legislation protecting fish life.

This is not all. Look at figures a moment. The Census Bureau at Washington, in 1909 report, states the value of whitefish fisheries for that year to have been $524,650; while the United States in 1910, on that portion of the 73,000,000 pounds of fish sent to us from Canada that year, paid in duties alone $463,663. These latter figures were taken from the "Reciprocity Report," which shows a total value of food fish and fish products for that year from Canada alone of $4,920,236. Expensive, is it not? Duties paid for year 1910 almost equal in value the total catch of whitefish in United States for 1909. Neither is this all. The worst is in prospect, and will be given as briefly as possible. The Canadian people now chafe under the situation that has arisen through the organization of an American monopoly to control the Canadian Great Lakes and other fisheries, the operation of which, in order to supply the insatiable demands of the great cities of the United States, deprive the Canadian people, and to their great injury, of the carefully estimated amount of 95% of their catch of food fish. Already the Georgian Bay Fishery Commission, alarmed at the decrease in the annual catch of whitefish, have recommended to the Dominion Government a measure which would prohibit the export of this species. This half-way method does not, however, meet with the views of the Ontario Game and Fisheries Commission, but rather that the power of the trust should be broken and that the requirement of all classes of her citizens should first be met, equal attention being paid to the coarse as well as the finer varieties of fish; and, need we be surprised at their position, when we realize the fact that, immediately preceding the Lenten season, two years ago, in the United States, the fish trust advertised cold storage suckers and mullet at five cents per pound. Truly an ennobling prospect for the poor as they approach this annual period of fasting and prayer—a disgrace on any nation. Ontario doubts not that prohibition of exports in a modified form would be a powerful factor in remedying the deplorable condition both of her fisheries and her fish market. Expression of their views is found in the conclusion of the Commission under general recommendations in regard to the Great Lakes commercial fisheries, section 8, and is as follows: "That steps be taken to have the export of whitefish and lake trout prohibited for a term of at least five years by a Dominion regulation, and that, meanwhile, the further export of these fishes be prevented by the endorsation of licenses issued to the fishermen and fish buyers, with a provision to that effect." In addition to the above, the Commission deals quite extensively with the question of an export duty on both coarse and fine commercial fishes. While both Dominion and Provincial Fishery Departments are showing great interest in these matters, there appears another powerful factor in the matter. Reference is made to the Commission of Conservation of Canada. In one of its reprints of report of 1911, quoting from the report of the Manitoba Commission regarding whitefish size limits, recommends closing of summer fishing at least in Lake Winnipeg, such close season to continue until evidence forthcomes that the fishing resources of waters named had reached their former plentitude—a gradual increase in size of mesh of nets to be used and that, in view of the fact, brought to the attention of the Commission that, during the winter of 1911, several carloads of whitefish, caught in the waters at the north end of Lake Manitoba, were found by the buyers after purchase to be fish of such small average size that it was necessary to hold them back until catches of larger sized fish could be secured to mix with them before exporting the whole. In this way alone was it possible to raise the average of the shipment to a marketable size. Continuing, this report states that they are aware of the fact that a large quantity of whitefish, under the legal size of two pounds in the round, the results of the previous years 1909-10, are still held in storage in Winnipeg. Now, in view of these facts, the Commission concludes as follows: "We are convinced that it will be absolutely necessary to require the use of nets of not less than five and a quarter inch extension measure, if such a destruction of small whitefish as that we refer to is found to continue." There can be for us but one logical conclusion regarding the above facts, viz.: That any state that permits the sale of these immature fish becomes the dumping ground of the illegally taken fish of our neighbors, and, if from Canada, you may rest assured of their treating in like manner all illegal and immature fish from your own state. When, "under present conditions Canadians, when buying fish, actually pay a profit to four different persons, viz.: First, the fisherman; second, the wholesale fish dealer; third, the jobber or middleman; fourth, the retail fish dealer," is it to be wondered at that this Conservation Commission of Canada, after investigation, declare new regulations desirable and propose a list of recommendations drastic in character that will save to Canada her great fishery interests? If these two methods of determining the size of mature fish for purposes of legislation are to be used, it becomes necessary that there be established a standard, a harmonizing of pound and inch methods, quite as necessary as the standardizing of sizes of output of hatchery and certainly of more far reaching importance. In the consideration of the question of determining just how long in inches a whitefish must measure to harmonize with the present standard of practically two pounds to the round, it may be stated that one fish culturist of forty years' experience writes as follows: "A twelve inch whitefish will not on the average weigh one and a half pounds, and in some waters not over one and a quarter pounds." The Hon. John C. Speaks, chief warden, Ohio Fish and Game Commission, writes in this connection that, in his opinion, it would be an excellent idea to have a conference in Washington or at some other convenient point, and endeavor to decide upon some policy or plan which will insure co-operation, while another commissioner has offered to make weights and measurements of whitefish during the coming season's operation and report results. The department at Washington will also be requested to ask fish culturists operating whitefish hatcheries to take weights and measurements of whitefish taken during the coming season, having in mind the solution of these questions. The present fish culturist of New York, in his book on "Food and Game Fishes of the State," 1903, page 313, speaking of the whitefish, makes the following statement: "In Lake Erie, in 1885, the average weight was between two and three pounds. The length of adults will average twenty inches." After much thought and observation, it is the personal opinion of the writer that, for purposes of legislation, the inch measurement of a two pound whitefish should be sixteen inches or more. In what has been said about advocating size limits in detail, it is to be understood that the larger part of the credit of establishing such size limits rests upon this Society and the many fish culturists and heads of departments who for years have advocated this measure of protection.

With personal acknowledgments to the many state commissioners, to provincial departments of fisheries, to the commissioners at Washington and at Ottawa, to the many eminent fish culturists of state and national departments, to the Commission of Manitoba, and the Conservation Commission of Canada, for their valuable reports, to your great big member, Kelly Evans, of the Ontario Commission, to the contrary winds that have only served to stimulate us to labor in the interests of the poor who suffer because of lack of food, and to the American Fisheries Society, its members and friends, with acknowledgments to all for assistance given in the production of this paper, it is concluded with the sentiment of Evans that no great stretch of imagination is required for us to see and conclude that the whole question of the commercial fisheries, not only of the Great Lakes bordering upon the two countries, but all waters producing marketable fish, is not only of national, but of international importance, and that, if we would conserve that which is of vital importance to the food supply of a continent, we must have protective size limits that will afford each fish an opportunity to at least once produce its kind before capture; and you are urged, after deliberation, to write into your reports plainly the best methods required to produce such results, and to write across the heavens above this continent such ruling that he who runs may read, that states and provinces may have no excuse for lack of harmony in the laws of protection and conservation, and that justice and fair dealing may prevail.

FISHWAYS FOR THE RANK AND FILE

By W. O. Buck

In his clear and complete article on fishways, published in the Report of the United States Fish Commission, Part II, for 1872-3, Mr. Atkins remarks that it had been deemed expedient to provide fishways for salmon, shad and alewives only, that is, for fishes specially classed as migratory because they run from the sea into streams to spawn. It long had been realized that obstructing the passage of these fish up the streams must be fatal to the fisheries, and even now when artificial propagation has advocates so enthusiastic as to claim that it is the proper method, no one will go so far as deliberately to throw away the aid which fish bring to the good cause when allowed to spawn naturally.

The recognized American authorities on the subject, Atkins, McDonald, and Von Bayer, after carefully reviewing all the various fishway designs and approving several of them, conclude by each proposing a new plan. This argues that preceding ones were not entirely satisfactory.

After mulling over the subject a few years, the writer followed these distinguished examples and planned a modified form of fishway for the dam at Grand Lake Stream, Maine, and procured the consent of the powers that were to have it built. Some members of the Society will recall a description of this fishway, presented some years since and accompanied by a promise to report later as to its efficiency. Observation of the fishway for a year or more failed to reveal the passage of salmon through it, and Mr. Story, in charge of fish cultural work at that point for the past three years, writes: "In regard to the fishway, I doubt if a salmon ever went through it. My idea is probably worthless, but I think the great fault is lack of inducement —remedy, more water, also place fishway near greatest current. I think the fishway should vent all the water needed in low water. We know that fish could go up this fishway, if they wanted to; we also know they will leave the fishway and go to the open gate, even though they cannot get up, which goes to prove that in order to make fish do as we want them to we must make conditions conform with their instinct."

An excellent and expensive fishway at Bangor, on the Penobscot, was at one time examined by the State Commissioners and found to contain salmon in nearly or quite all its pools, and salmon are found in the river above the dam. This seems to argue the efficiency of the fishway. Nevertheless the pool below the dam is an excellent one for the fly-fisherman to exercise his art and the fish do so abound there that good catches are made in spite of the fact that salmon do not feed in fresh water and it therefore becomes necessary to attach the hook to some other portion of their anatomy than the appetite. Moreover, this is a comparatively low dam and the water-level below is determined by the tide, which rises and falls some 10 feet. At high tide and especially at a high spring tide, or on occasion of an easterly storm when the water is driven into Penobscot Bay, it is probable that salmon can pass the dam by way of the log sluice, and the assumption (*quite gratuitous*) that this is the road by which they go would explain their presence above the dam and also their waiting at its foot.

Of the three classes of fishes above mentioned, whose tastes have been considered in the planning of fishways, salmon are doubtlessly best able to meet and overcome difficulties and we have heard their verdict in regard to two of the plans proposed. In offering a new one, the writer justifies himself not so much on this verdict regarding the older plans as upon certain observed facts, which may be set forth briefly.

1. In handlng young fish in troughs it is usual to set the trough with some slant so that in cleaning the bottom the sediment can easily be brushed toward the foot. This operation is helped by raising the dam or removing the outlet plug so that the water is drawn down until only a thin stream remains in the upper part of the trough, but the young fish

will push up in this to the intake even though they are not half submerged.

2. Similarly young salmon have been seen to crowd up on the apron of a dam to the very gate when all the gates were closed and the only flow was leakage hardly more than enough to keep the planking wet.

3. In the traps in use at Grand Lake Stream the salmon are captured on their way down from the lake to the stream, being guided by an arrangement of nets into a small enclosure. When they seek to pass out of this, their search is upstream and the only upstream egress is through a funnel-shaped opening at the bottom and only 6 inches square. Small as this is, the largest salmon in the stream always find and pass it promptly. As there are usually some in the catch weighing 7½ pounds, and a sea salmon still larger is occasionally taken, it is evident that salmon are willing to pass through a very small opening, if only it is in the right direction to meet their views.

4. This fact is still further shown by their behavior in the enclosures in which they are held during the spawning season. The barriers forming these are of fine netting held by stakes and weighted to the bottom by chains laid in a fold of the net. If there is a small gap under the upstream net, where the net does not fit the bottom closely, the fish will wriggle through, even digging under or lifting the chain if necessary.

5. On a steep sloping ledge covered with moss and slime, trout have been seen to make their way upstream in water too shallow to cover them and which was very swift. In that case they would push ahead a short distance and stop, possibly catching hold of irregularities, or more probably by resting the broad pectorals on the bottom and allowing the pressure of the current to hold them at anchor. That the current will have this effect a simple experiment will show. Put a shingle at the outlet of a sluice so that its thin end will rest on the bottom and the thick end will project below the end of the sluice. Half the length of the shingle

may thus project before it will be moved downward by the current. Now raise the thin end a trifle and see how quickly the current will have the mastery.

The suggestions for a fishway, which it is desired to base on these observations, are: 1. The bottom of the fishway should be uninterrupted. A swift current is no great obstacle, if only the fish have access at all times to the bottom. Nor is a smooth slippery bottom objectionable but rather the reverse. No argument against this view can be based on the fact that the bottom of most streams is irregular, for in the roughest streams everything is covered with slimy, slippery growths.

2. There should be a continuous smooth flow along the bottom. To secure this it is proposed to build a straight steep sluice and insert partitions in this sluice leaving openings under each partition all the same height and across the entire width of the fishway. It is evident that the total fall will be divided into as many steps as there are partitions and the fluctuations of level above or below the dam will also be so divided and the flow will never be too small nor too great, provided the right number of partitions has been inserted.

This mode of reducing the head and thereby the velocity of the current is that of the Hockin fishway figured by Mr. Von Bayer (Bulletin of the Bureau of Fisheries, Vol. 28, 1908) and at certain stages of water might be that of the Cail and Von Bayer fishways also. The plan proposed differs radically from all of these, however, in three points: 1. In having the bottom a continuous slope without steps. 2. In having the openings at the bottom and under the partitions rather than through them, and: 3. In the extension of the openings across the whole width of the fishway, thus avoiding horizontal eddies. It is not claimed that there will be no eddying but it is believed that the eddies will be vertical and mostly above the bottom and that there will be a current along the bottom constantly in one direction, although doubtless varying in velocity at different points, being slower between the partitions than under them. The build of fishes enables them to head upstream with less effort than in any other direction, or just as a weather-vane points to windward. Their whole energy may, therefore, be applied to stemming the current and every move will set them forward in the right direction. Prof. Elias Loomis once said to his class: "If you wish to know how anything in nature will behave, you must experiment; you can't reason it out beforehand." In suggesting this plan for a fishway the writer wishes to admit that the fishes still hold the same veto power which they have been exercising at their own sweet wills in regard to all previous plans. That is, although the plan is based on observed habits of fish, as well as hydraulic principles, still it must be admitted that no fishway has yet been built on this plan and submitted to the fish for approval. For the benefit of the daring innovator who may venture to build one, a few further suggestions are offered.

1. Have the openings at the upper and lower ends of the fishway as low as practicable, that is, not only on the bottom of the fishway but on the bottom of the stream, or as near it as may be practicable.

2. Where the opening is above the bottom of the stream, extend the bottom of the fishway beyond its sides up or down stream, as the case may be, so that fish may pass to and from the apron thus provided in water less swift than that of the fishway itself.

3. Where practicable, build the fishway above the dam. This last because there are almost sure to be leaks, and a leak into the fishway through a crack in side or bottom is far less dangerous than a leak out of it. This is not mere theory, but is based on the observed fact that numbers of salmon have been found caught and killed by being held by pressure of water at a crack in the planking above a dam.

In conclusion, it may not be amiss to refer briefly to the points in which existing fishways seem to the writer to *come short*.

1. Fishways of the older styles which have the advantage of an inclined plane for the bottom have this either vitiated by partitions producing steps or offset by the disadvantage of whirling currents and eddies. The Grand Lake Stream fishway is faulty in both respects.

2. All fishways having an intake at the top are open to the further objection that flow of water through them varies greatly at different levels or stages of the lake or stream above the dam. And this variation is not limited to the flow over the top, but, as the level varies, the rate of flow through submerged openings, if any, varies also.

An effort is sometimes made to obviate this difficulty by completely enclosing the upper pool of the fishway so that there is no overflow into it even at the highest stage of water, but it is supplied through an opening submerged at all times. This is good so far as it goes, since the variation of level will be halved and in some situations halving will keep it within the limits of the powers of the fish for which it is intended. But it is clear that such an expedient would not meet conditions like those at Grand Lake Stream, where the fluctuations extend to the whole height of the dam.

Thus far we seem to have wandered from the subject announced at the start and to have been considering salmon instead of small fry. But the fact to which attention has been called as true of the ablest fish in the stream is still more true of all the rest of its inhabitants. All prefer a foothold and most of them absolutely require it. Moreover, all are in a way and in some degree migratory and all are liable to find themselves downstream of an obstruction. The migrations of salmon, shad and alewives are determined by the spawning instinct and by the search for food and suitable temperatures. These motives affect all the creatures in the stream more or less, so that it is doubtless true that differences in the migratory habits of fishes are of degree rather than of kind.

Nor can it be doubted that it is equally important to keep the stream stocked with the smaller creatures as with the larger. It is as true in the water as out of it that the higher is absolutely dependent on the lower and the all-important problem of fish culture is the food problem. Doubtless many of the disappointments met by those who try to stock ponds and streams are due to want of attention to this point. Too little inquiry is usually made as to the amount of food in the water or the date at which it becomes available. Fish hatched prematurely and planted in water so cold that none of the food creatures are yet developed in it, or fish produced or planted in too great numbers for the food-supply of the locality must perish. These statements sound almost exactly like platitudes, but they must be repeated as long as they continue to be disregarded.

DISCUSSION

Prof. L. L. Dyche, Kansas: I am interested in this subject of fishways, because the Kansas Legislature passed a law, influenced largely by a number of petitions sent in by citizens, compelling owners of dams and other obstructions in streams, which prevented fish from going up stream, to put in fishways. Then the matter was turned over to the Game and Fish Warden and he was told to see to it that the fishways were put in.

We immediately devised the very best fishway, for the least money possible, that we could, with the help of a number of engineers; we published an outline of it in the proceedings of this Society last year. However, the planning of a fishway on paper and publishing it in the Transactions is one thing, and building one that will actually permit fish to go up stream is another. However, we had to make a start of some kind to satisfy the demand for fishways made by people who live above the dams.

We have superintended the building of several fishways, and no two of them are alike, because we find that the dams and obstructions in streams are different, and the streams themselves differ greatly.

The chief ideas in this fishway, as you will see by examining the plan that was published in the proceedings last year, is a trough, some four or five feet wide, starting up above the dam, and running down to some pool below the dam, and having one foot elevation to five feet of run. We put in three or four of those built along the lines suggested in the plans that were published in the proceedings of this Society. As yet we have not had time to secure definite information as regards their success. If fish do not go up through them, they are of no value.

At Wichita, Kan., a modified form of this fishway was put in over or rather around a dam that was built across the little Arkansas.

Mr. Wells, City Engineer of Wichita, and myself figured out a plan of having a fishway that would start right up close to the dam, so that the water would really fall over it and on it. The fishway started close to the dam and went north until it got past the abutment; then it turned and went west behind the abutment, and reached the water several feet above the abutment. Of course a trench was dug behind the abutment, and when the fishway, which was built of steel, was finished, that part behind the abutment was covered with earth. In the building of such a fishway some of the rules for building such structures were violated. In a way it was an experiment. Mr. Wells watched this fishway last spring during May and June, as many people had grave doubts about the thing "working." The fact is that both the engineer and myself had doubts. However, Mr. Wells reported to me that the fishway was a great success. Many fish went up, especially catfish. The exact number and varieties that go up during a given length of time we hope to be able to report at some future meeting. However, the fish went up in such numbers that it was necessary to protect the end of the fishway from poachers at night. It was discovered that certain persons were stealing the fish that came up through the fishway.

C. K. Cranston, Oregon: What were the species?

Professor Dyche: Many catfish, both bullheads and channel catfish and a good many scale fish, but I could not be sure of the species from the description given.

I studied the Cail fishway and others, but it costs a good deal of money to build them. The fishway we have planned is not expensive. We hope in the future to determine its efficiency for different streams and for dams of different heights.

In Arkansas City, Kan., a fishway has been built following plans published in the proceedings. It has a straight run from the river below the dam to the water above. It is on the south side of the river and passes up along the side of the abutment. This entire structure is built of cement; it is as solid as stone. I was told by fishermen that fish went up this fishway. I went to see for myself, but it was in July and about noon time. I saw no fish in the fishway. Another year may furnish some definite information, when we hope to have capable men in charge of these fishways.

Mr. Cranston: How did you meet the difficulty of the varying height of the crest of the dam caused by these steel sheathings you described over the Wichita dam?

Professor Dyche: The fishway was built underground, starting below the dam and passing around behind the abutment and reaching the water above the dam.

Mr. Cranston: So that in the high stage of the stream the fish would enter the upper stream well below the surface?

Professor Dyche: Yes. But even in low water the fish would come out a foot or more under the surface of the water.

Mr. Cranston: Then at a very high stage would not the pressure of the water from the head be too great?

Professor Dyche: Yes. Fish will not go up stream at all when there is such pressure. High water is a catastrophe for fish, and they do not try to do anything under such conditions except to protect themselves in more or less sheltered places.

Mr. Nathan R. Buller, Pennsylvania: I am very much interested in this fishway proposition before the Society at the present time, and I would like to get some information in regard to fishways.

One of the nightmares of the Commissioner of Fisheries is caused by a law that compels all dams built in Pennsylvania to be provided with fishways for the fish to ascend the river. The Susquehanna River is a shad stream emptying into Chesapeake Bay. The shad ascended the river and there were fishing rights granted by the state to a great many owners of land along the shores of the river. Some years ago the Pennsylvania Water & Power Company erected a dam across the river, 65 feet high and almost a mile in length. There was placed in that dam on the Lancaster County side a Cail fishway, the entrance being at least 1,200 or 1,500 below the breast of the dam. This season I had a representative on the ground from the time the shad fishing season opens until thirty days after the close, making a daily investigation to find out whether there were any fish ascending the fishway. He would have the fishway emptied and drawn off twice a week. On four different occasions I was there myself, and we failed to find any fish ascending or coming through the fishway, with the exception of four or five German carp; and the supposition is that they were going down instead of going up. They were all pounded to pieces. But as far as the shad is concerned we are absolutely certain that not a shad ascended the river.

Now, the people living on the upper waters demand an adequate and practical fishway into that dam for the purpose of allowing the shad to ascend the river, because they claim that this dam has taken away their inherent rights.

Now, if there is anybody in the Society that knows of any model or any plan that is practical for the ascent of the shad, I would like to learn about it. The shad is probably peculiar in its manners as compared with some other fish. For instance, the shad will not leap, and they will not pass under a shadow. The only possible fishway that could be placed in that dam, of any benefit to the shad, would be one where there would be no obstruction over the top of the fishway; because if a shadow is cast across the water they will not pass under the obstruction.

The conditions in the river are deplorable. There were caught at the breast of the dam this season in round numbers about 40,000 shad. The barrier was there and that was as far as they could go. Besides that I have found there on different occasions millions of eels, 3 to 4 inches in length; and millions of them dying on account of the barrier being placed there; and if it is possible to do so I would like to learn of some model or plan of a fishway for that dam that would allow at least the eels to ascend the river.

PROFESSOR DYCHE: My observations are confined to the kind of fish we have, such as catfish, bass, German carp, buffalo and suckers. I know nothing about shad or salmon, and our fishways are built for such varieties of fish as we have in Kansas. The dams we have experimented with are from 6 to 16 feet in height. It may be a more serious thing to put a successful fishway over a dam from 20 to 40 feet in height.

MR. BULLER: This dam is 65 feet high.

PROFESSOR DYCHE: That is too much of a dam for me. It might discourage the most ambitious of Kansas fish.

MR. CRANSTON: The reading of the paper and subsequent discussion has been very interesting to me, and has called to my mind a question in a problem that I had to confront on which I think possibly I may get some information here; and in order to make this question clear I will briefly state the particular instance that I have in mind.

In the Clackamas River, a tributary of the Williamette, a large power company has completed the construction of a dam, for the generation of power, which is 87 feet high. The Clackamas River is a fine trout stream and is a highway for the ascension of all the native salmon, particularly the chinook and steelhead. In compliance with the law, we insisted on the construction of an adequate fishway over this obstruction, and the company that erected it has placed there a concrete fishway which has as many pools as there are feet of rise, that is, 87 pools, a foot of rise to each pool. It starts in a deep pool at the foot and has a tortuous course passing under itself once; it is built entirely of concrete; and I am told it has added to the cost of the structure about $20,000. It has not been installed long enough so that I can report as to its actual workings; but the entrance of the last pool into the upper pond is the one point of objection which I raised to it on inspection.

Now, my question is whether the salmon, trout and other fish that inhabit this stream, of which most of you have some knowledge, would be turned back by the fact that in passing from the last pool into the upper waters of the pond, it will be necessary for the fish to pass through a gate, and through a dark tunnel that is as long as the crest of the dam is thick, some six or eight feet. The flow of the water into the fishway is regulated by a large valve operated by a hand wheel on the crest of the dam; and in case of very high water, this valve being operated to prevent the inrush of the water, would absolutely stop the passage of any fish, the flow being regulated by the manipulation of this valve. I haven't any doubt in my mind, from observing the construction of the fishway, that it is practicable in all its course except this one place; but that point "stuck" me, and I want to ask if there is anybody here who can give me an answer based on experience as to whether that would be an insurmountable obstacle.

MR. BULLER: There is no doubt in my mind that the time is not distant when practically all the streams in the state of Pennsylvania will be a succession of dams; it will be done for the conservation of the water, and I would like to ask whether the construction of these dams will be any hindrance to such fish in the river as pickerel, pike and bass, and the other fish that inhabit our rivers.

MR. NEVIN: I claim they won't want fishways at all.

MR. BULLER: I agree with you. I never saw a fish ascend a fishway yet in a brook trout stream. In Broadhead's Lake, in Monroe County, a stream about the width of this room (about 40 feet) there was an 8-foot dam constructed in that stream quite a good many years ago; and I have seen trout by the hundreds leap that eight feet and pass on up the stream. The owner of that dam concluded that there should be a fishway placed in it. There was a Cail fishway placed in it; and I have scrutinized it at the time when the fish were ascending the creek, and I failed to see a single fish go up the fishway. As I say, I have never yet seen a fishway that the fish ascend.

But what I want to bring about is this: Knowing these conditions, I would like to see that law taken off our statute books of Pennsylvania; and what I would like to learn is whether in your opinion it would have any effect on such fish as the bass, pike, perch and catfish that are natives of our waters, and whether it would make any difference whether they had a fishway to go up or down or not?

MR. FEARING: The last thing we want a fishway for is eels. I think it is a recognized fact, and has been for ten years, that the eel brings forth its young in salt water; and it has been ascertained in Germany to a certainty that distance is nothing to an eel. There are records in Germany of eels, on their way down to salt water in the bearing season, having covered three, three and a half and four miles of absolutely dry land. The old idea of eels procreating in fresh water is exploded, and you cannot keep eels out. Most of us who are interested in the breeding of trout are looking for a way to keep eels out and have never yet discovered how to do it.

MR. BULLER: It is a well understood fact that eels will go probably where no other fish will; but we have failed to find any of them ascending the Susquehanna River through this fishway. We have found them on the rocks as high as 40 feet above the river, have found them right on the face of the rock, wherever it was damp; but this stream that is pouring over the dam is of such volume that it is impossible for them to ascend the river; and the eel in the Susquehanna River is a valuable food fish and supplies food, when it has the chance to ascend the river, to a good many thousand people. But, of course, we do not like them in our trout streams.

Mr. Fearing: I would not worry about their going anywhere. They are like Mark Twain's steamboat. You will remember he said if there was a heavy dew and a man spitting tobacco juice over the bow the steamboat would go. (Laughter.)

Mr. Buller: We found them dying by the millions. They could not get up through the fishway.

Mr. Fearing: But you will find millions got there just the same, and they got there over the slime and the bodies of the dead and dying.

Mr. G. H. Thomson, Colorado: This matter of fishways is especially interesting to us in the west; and we have more to contend with on these fishway propositions in our irrigating ditches than anywhere else. It is absolutely impossible for our trout to get above some of our dams; and after stocking our streams above the dam we find that the fish go down, but they cannot get back.

Mr. J. Q. Ward, Kentucky: I wanted to ask if the paper read on fishways will be printed in the annual report?

President: Yes.

Mr. Ward: And the description of the dam and fishway built by Professor Dyche in Kansas is already printed in the Transactions of last year?

President: Yes.

Mr. Ward: How can I get one of those reports?

President: The Secretary will send it to you. Write to Mr. Ward T. Bower, Washington, D. C.

Professor Dyche: Last spring one day we placed 6,000 yearling catfish in a pond that was 50 feet long and about 20 feet wide; the water was about three feet deep. That pond was connected by a 3-inch pipe that led under the ground to another pond 60 feet away. During the night the outlet to the pond got partly stopped up with moss and the water rose four inches above the usual level. About 5,900 of those catfish came up within six inches of the surface, went down into the supply pipe and took the underground passage against the current to the next pond. When we drained the second pond we discovered that 5,900 went through in one night. If they will go through a place like that it would seem that they would go through almost any opening and especially through an ordinary fishway.

Mr. Fearing: You never knew a catfish to go up a fishway, did you?

Professor Dyche: Yes, they do in the Michita fishway, both bullheads and channel catfish, and in goodly numbers.

President: I will give an experience that I had in Minnesota. It has been a nightmare with me. For years I have got more damning about fishways than for anything else.

Mr. Nevin: Not more than I have.

President: Every man that did not have fish above the dam blamed the Commissioner. My experience in fishways, had through a number of thorough tests, is that muskellunge, pike-perch, pickerel and bass will not go up a fishway to any extent. Bullheads will go up a fishway; and I will tell you why. I ran across a fishway on a dam after I had driven 20 miles to get a man to construct the fishway for a farm, but when I got there I found he had already constructed one. He built it out of two boxes made of planks, in which he had bored two-inch auger holes to let the fish through, and we found a bullhead in every hole, but not another fish. I know that bullheads will go up fishways because it is in them. But I believe that the fishway is vastly overrated. There is a good deal of myth connected with fishways, although it is true that trout and salmon will go up fishways.

Mr. Seymour Bower, Detroit: I would like to inquire what advantage there is in fishways, anyway. I am not speaking of their use for salmon and trout, and perhaps some other kinds; but do you have any idea that you will produce any more fish in a river with a series of dams in it, where they cannot pass from one pond to another, than if they had free range? I do not believe you will have a pound more of fish with fishways. If not, what is the use of going to the expense of building them?

President: That is my view.

Mr. Bower: Some of the rivers in Michigan are being utilized for water power, thus creating large reservoirs and greatly increasing the water area; and there is no question but what these rivers, as a whole, are producing more pounds of fish today than they were before, whether fishways are installed or not.

Mr. Fearing: I would like to state an experience in Long Island, N. Y. This whole question of fishways is becoming a serious business with breeders of trout in the natural trout streams on Long Island. In the old days there were a certain number of small fishways in all the streams on Long Island. Trout naturally will seek salt water if they can get to it. They go down to salt water, clean themselves, and in the breeding season came back. In nearly every stream emptying into Great South Bay in the old days there were fishways and the trout ran in and out. In the multiplication of fishing clubs, sporting clubs, etc., everybody is jealous of everybody elses' waters, and those fishways are then shut up. The result has been that all the trout of Long Island have gradually been dying out. I wish Dr. Bean were here, because he has studied the question very deeply; and all the best authorities in the east have come to the conclusion that the fault lies absolutely in the inbreeding of the trout; and that is all due to the fact that the trout have no means of replenishing their blood; that the same trout inbreed and inbreed, and they breed tremendously, and the young fry grow to be fingerlings and then they die, and there has been found no other explanation. At first they thought it was bad water, but it is absolutely now supposed to be from the fact that there is no new blood, and in all the places on Long Island where they breed trout now, they put in a certain amount of new blood, fish taken from Pennsylvania, Rhode Island, Connecticut and Massachusetts; and the fish are all coming back again.

In every case where a man has a small stream or a small pond, where there is no chance for the trout to come in from Great South Bay and put in new blood, they grow large. They are cannibals, as we all know, and those ponds end up with a quantity of large fish that won't rise to a fly; and they eat up all the other ones, and the young trout die.

Mr. Seymour Bower: I do not question the benefit of fishways for trout. It is quite necessary for trout to be able to ascend to suitable spawning grounds, which they cannot do if there are impassible barriers. We also know that trout, where they have access to the sea and go to salt water, or brackish water, improve greatly; it seems necessary to make them strong, vigorous and healthy.

But it is quite a different proposition, these large power reservoirs in rivers, such as we have in Michigan in streams like the Muskegon River and others, where the dams have a head of from 30 to 60 feet. Each of the divisions between dams is a perfect unit, containing feeding grounds, breeding grounds, quiet water, rapid water and all the conditions essential to the production of fish at their best from the time of their birth till they are full adults. Under such conditions I see no advantage in having fishways.

Mr. Cranston: I believe I can promote mutual interest by a few remarks and a few photographs I propose to circulate without interrupting the subsequent discussion.

We have had under consideration a fixed plan for a standard fishway proposition. But my belief is that every obstruction in a stream is a case in itself, and that it is next to impossible to establish or install any fixed standard fishway that will meet all conditions. To demonstrate the truth of that position, I have a few photographs illustrating two practical fishways in my district. I personally have inspected both of these during the time these photographs were taken, and I know they are practical fishways. The only objection is as to their capacity. We are working on them to improve them; and in one case advantage was taken entirely of natural conditions. There is practically no semblance of an artificial structure there, but just an improvement of the natural conditions to turn the flow of water through crevices and rifts in the barriers. I know that both of those fishways are practical, and still a casual observer would not probably know that either of them was artificial at all. I will pass these pictures around for examination.

President: I think the discussion has produced one result, and that is you cannot have any fixed rule; that every case must be governed according to locality and the kind of fish in your stream. From that standpoint the discussion has been a success.

PUBLICITY

By B. G. Merrill

Publicity is a great word.

To make a thing public is to make it known to the people, to all the people; and in America that means a great deal. For, by the knowledge and the will of the people, great things are accomplished, great ends are wrought out.

But in some manner the people must be reached; facts must be put before them, and their minds must be held to the point before they will show much interest or take part in any line of action.

As a rule, men think most about the things which lie nearest to them; but it cannot be truthfully said that the fishing interests lie nearest to any great number of our people, in so far as their realization of the importance of the subject is concerned.

Not every man is an active sportsman, nor is every man actively engaged in the fishing industry; but nearly every one is in some way a consumer; and through some one of these channels of interest we ought to gain access to the minds of the people, who ultimately have the power to influence legislation.

It is then by a process of education, or *publicity*, that many who have not been interested in particular must be made to feel that the matter belongs to them personally. In some way we must put the facts before them, arouse individual interest, and shape public opinion.

For "It is well known that public opinion is the strongest force in all the world but one. Public opinion is the dominating force at all times, and never yields its dominant sway of the will of the people until truth proves its error. So truth becomes the strongest force in the ultimate."

The lack of public opinion upon questions pertaining to the welfare of the fishing interests is due to the fact that the people in general are not informed on the subject and do not realize the importance of the interests which *they have* at stake.

Public opinion is essential to obtain increased appropriations for the protection, propagation, and distribution of food and game fish, and to secure the enactment of legislation for the preservation of our lakes, rivers and streams. To secure this great force publicity campaigns are a necessity. Such campaigns may be conducted in many ways.

A publicity page can be prepared, and offered gratis, to the leading county papers of the country, in the form of plate matter. In this manner a large circulation is secured at a small cost.

Through the medium of specially prepared papers and addresses the most forceful and interesting facts and figures may be put before the people.

Fish commissions in every state should issue bulletins to the newspaper press of their respective states. This form of publicity has been adopted by many departments of state and federal governments with gratifying results.

In Illinois we have the "Fish Conservation News-Letter," which publishes many of the papers and addresses from the Transactions of this Society (The American Fisheries Society). Copies are sent to each legislator, to every person interested in recreative or commercial fishing, whose name and address can be secured, as well as to each candidate for state senator and representative, and to a large number of editors of weekly newspapers, many of whom have republished some of its articles. We also have the "Illinois Fisherman," a monthly journal devoted to inland fisheries, commercial and recreative, and we have reason to believe these will assist materially in securing the enactment of desirable amendments to our present law, and in increasing our appropriations.

If every member here would occasionally prepare a short article on the subject he is particularly interested in, and have it published in their local newspaper, it would aid considerably in creating favorable public opinion. We have gentlemen in this Society who are qualified, by education and practical experience, each to take his place among the foremost magazine writers on special subjects. Why do we not hear from them through the leading magazines?

We have no one to blame but ourselves for the non-recognition by the general public of the importance of our fishing interests, and the danger to the health of the people, as well as the fishes, of this country in the indiscriminate dumping, by corporations and municipalities, of all manner of refuse into our lakes, rivers and streams.

Is not this subject of sufficient importance to justify this Society in using its far-reaching influence with the Bureau of Fisheries to secure the publication of a monthly bulletin to be sent to the newspaper press of this country?

CESTODE CYSTS IN THE FLESH OF MARINE FISH AND THEIR BEARING ON FOOD VALUES

By Edwin Linton

I. POPULAR INTEREST IN PURE FOOD TOPICS

One will look far to find a subject upon which the general public is more sensitive, or to which it reacts more readily than those matters which relate to its food and drink. A little knowledge of the subject matter of bacteriology, for example, while it may not become exactly dangerous, may easily become inconvenient and trouble producing. The public is justly sensitive to the adulteration of its food and, very rightly, is ready to visit swift and sure punishment on those who for increase of their own profits make the article which they sell different from the description which appears on the label.

II. PURPOSE OF THIS PAPER

There is a class of facts, however, that is related directly to our food supply, which man's cupidity has not originated and concerning which the public is very imperfectly informed. This is the class of facts that may be introduced at this point under the caption of animal parasitism. It is my purpose in this paper to discuss the question of animal parasites, but in so doing I shall aim not so much to impart information as to disclose points of view that should go some way toward dispelling prejudice. Some attempt of this sort seems to be made necessary in order to prevent misapprehension concerning the food value of those species of fish which are liable to be parasitized in portions that are used for food.

III. GENERAL CONSIDERATION OF ANIMAL PARASITISM

It does not require much experience in the classification of living things to teach one that the boundaries of what at first sight seem to be natural and obvious groups are far from being hard and fast lines. For example, what at first blush appears easier to do than to divide animals into parasitic and non-parasitic forms? An attempt to place the animals with which one is acquainted in one or the other of these groups soon brings one to consider degrees of parasitism. For example, there are the familiar insect parasites, many of which lead independent lives but find their most congenial habitat in those jungles of hair and feathers which they find on the outsides of mammals and birds. Some of these insects, it is true, as the bot-fly, enact a part of their life history as internal parasites finding favoring conditions in the alimentary canal of the horse, but in their adult stage are as truly children of the light and air as the butterfly. Then, in such a classification, where is the mammal to be placed? During its uterine existence it is one of the best examples of true parasitism to be found in all the empire of nature. Following this important and essential act, though it is played, as it were, before the curtain is raised, comes another in which the young mammal is a highly specialized, but none the less true, ectoparasite. The classifier thus discovers, crown of creation though he be, that for a time he himself has been, so far as his method of taking and receiving nourishment is concerned, among the lowly ectoparasites and the lowlier internal parasites.

Shifting our point of view slightly, it may be remarked that the fauna and flora which are for a greater or less portion of their existence within other animals, are themselves living things, and their tissues may and do become food for some of the animals which eat them. An example, from many at hand, is a cestode (*Rhynchobothrium imparispine*) the adult stage of which occurs in the winter skate (*Raja ocellata*) and a few of its near relatives. Glancing over my check-list, I find that I have recorded cysts of this species from no less than 34 species of the marine fishes of New England. Now these 34 species comprise kinds such as silversides, smelt, mackerel, etc., which are eaten by a large number of species of our food fishes. Without doubt, therefore, every bluefish, bonito, flounder, mackerel, scup, sea-bass, squeteague, and the like, which has attained marketable size, has taken into its alimentary canal, along with its food, large numbers of larval tapeworms which have been as completely digested and with as much profit to the eater as were the tissues in which the cysts were embedded. Many examples of this sort can be named. Indeed it is worth while to say in passing that if the sharks and skates were to be exterminated almost the entire list of encysted parasites in the flesh and on the viscera of the bony fishes would cease to exist. The list of cestode parasites that are adult in the alimentary canals of teliosts is a very short one. while that of those which are adult in the intestine of the sharks and skates is long. Furthermore, I do not know of any single species of cestode worm that becomes adult in both a selachian and teliost. On the other hand, several examples have come under my observation of species of cestode worms which are confined to a single species of shark. A notable example of this is a large tapeworm which I have found only in the tiger shark. It has been present in large numbers in all the sharks of this species that I have examined, but has not been met with in any other fish. Its life history is as yet not known. In whatever host or hosts it passes its larval stage there can be no doubt that such hosts, together with the larvæ of this cestode of the tiger shark, are continually being eaten by other fish both teliosts and selachians. The tiger shark is far from being exclusive in its diet, the list of stomach contents ranging from a pure fish diet to the varied contents of the slop pail of a ship's galley, including even cotton yarn and tin cans. Similar cases could be cited if it were necessary in order to establish the proposition which I wish to make clear, viz., that although the encysted stages of cestode worms may have wide distribution amongst specific intermediate hosts which themselves form the food of an equally large number of species of fish and birds, they are, as a rule, able to resist the digestive juices of but a limited number of closely related species, in some cases, of but a single species to which they have become adapted. From this generalization comes the comforting thought that, even if we had not acquired the habit of cooking our food, which effectually puts a stop to any possible infection from encysted cestodes, the chances that a larva, which is known to become adult only in the winter skate, or in a single species of shark, should find congenial soil in the alimentary canal of a warm-blooded mammal, are too remote for even momentary consideration. In other words, animals, and among them we may include man, are naturally immune with respect to a large number of parasitic forms that undoubtedly from time to time find their way into the stomachs of the eater along with the food.

IV. PERSISTENCE OF PREJUDICE

The difficulty attendant upon the eradication of deep-rooted prejudices is well known. When the prejudice has to do with food material, and is not based on individual dislikes, but affects the people as a whole, such can be driven out only by fasting which merges on starvation, or by the reiteration of sound reasoning backed up by experiment and demonstration. Thus the splendid work of Field on the mussel and on the dogfish, although entirely convincing to those who with him put the matter to the test of taste, is but slowly bearing fruit, and an immense source of valuable food which has been unused, simply because of an unreasoning but by no means unreal prejudice, is slowly beginning to find its way into our markets.

In the interests of science it became my duty a few years ago to call attention to the prevalence of a cestode parasite in the flesh of an excellent food fish, the butterfish (*Prionotus triacanthus*). Since that disclosure I have found that a very strong prejudice has arisen against this fish in the minds of a few individuals. This result is no doubt natural, but since the case is fundamentally different from that of trichina in pork, or "measles" in beef, it seems to me to be advisable to make an attempt to prevent the prejudice, which as yet is confined to a few individuals, and based, in great part at least, on misapprehension, from growing to such an extent as to banish an excellent food fish from our markets.

V. IN DEFENCE OF THE BUTTERFISH

The butterfish is exceptional among our marine food fishes in that a considerable number of them have a small cestode encysted in the flesh. These cysts are small, one millimeter or less in diameter, and occur near the vertebræ, usually on the ventral side of the back-bone between the hæmel spines. Now and then a fish is found which may have many hundreds, or, in exceptional cases, a few thousands, of these cysts in the flesh. It is worthy of note in passing, and will be alluded to in another connection, that the act of removing the back-bone, which is sometimes done in preparing fish for the table, removes practically all of the cysts, even in the most highly parasitized cases. Now these cysts represent the larval stage of a small cestode whose adult stage is passed in the intestine of a limited number of species of shark, notably the hammerhead. And just here it must be confessed one finds himself face to face with an unpleasant and somewhat delicate situation. Cestodes are not only worms but tapeworms at that, and, say what one may, these words call up unpleasant associations. When it is learned, therefore, that the mess of butterfish, which a customer is about to buy, stands a good chance of having a greater or lesser number of larval tapeworms in the flesh, there should be little wonder if the customer, who is acquainted with this possibility, decides to buy some other kind of fish.

Possibly some one may say: Why not leave the case of the butterfish where it is? The demands of science have been met by recording the fact that a certain species of cestode exists, and that in the course of its life history it uses as its intermediate host a large number of species of fish, and for its final host one or two species of shark. That among its intermediate hosts the common butterfish is unique in that the cysts occur not on and in the tissues of the viscera but in the muscles. This objection has been sufficiently answered in the foregoing part of this paper. It now remains to instruct the public so that they may be able to use a valuable food fish without offending the most exacting demands for uncontaminated food and at the same time to show the true position which these humble forms occupy in the animal kingdom. I find from conversation with one who has seen a badly parasitized butterfish, but whose zoological education is that of the average citizen, that his line of thought is somewhat as follows: "The demonstrator showed me a fish whose flesh along the back-bone was full of little yellowish bodies that looked like fine fish roe. He said they were worms. Now you don't catch me eating wormy fish." In other words, the unfortunate word worm calls up visions of putrefying meat which should not be suggested by cysts in the flesh. I have examined large numbers of butterfish which have had these cysts in the flesh, but have never seen any signs of inflammation or of bacterial infection resulting from their presence. I therefore feel justified in saying that these encysted larvæ not only look like fish roe, but that their nutritive value cannot be much less than so much fish roe; that there is no evidence of any condition to suggest danger from ptomain poisoning; and that, therefore, there should be no hesitation about using butterfish as food. If one's imagination suggests unpleasant associations he may find relief in the thought that all the cysts in ordinary cases of even badly infested fish will be removed by the cutting out of the back-bone and its accompanying spines, between which the cysts occur.

At the risk of repeating what has already been said, the importance of the case demands that it be stated explicitly that there is no reason for apprehending danger of infection from the ingestion of these cysts with the food, and that there is nothing in the cysts themselves, even when one is acquainted with them by microscopic study, to call forth the remotest suggestion of a qualm at the thought of swallowing one of them. With full appreciation of another valued and even luxurious article of food, it may be said that any one who can swallow a live oyster, at the same time knowing, as the zoologist knows, what he is swallowing, should not balk at a butterfish, no matter how many cysts it may harbor in its flesh. Indeed, the case is hardly a parallel one, because in eating an infected butterfish the chances are that all, or nearly all, of the cysts will be left on the plate with the bones, while along with the ingested oyster has gone the entire alimentary canal with its contents and any of the parasitic fauna and flora of the oyster species that the individual happens to be carrying, to say nothing of the possible germs of typhoid, if the mollusk in question happens to come from fattening grounds which the sewage of a city reaches before it is rendered innocuous by the cleansing waters of the sea.

With respect to the occurrence of cestode parasites in the flesh of marine food fish I have already pointed out (10) that the case of the butterfish is an exceptional one, an examination of other food fishes of the Woods Hole region having shown that the occurrence of parasites in those parts of the fish that are used for food are extremely rare, more unusual, I am sure, than is the case with the warm-blooded animals which form our staple flesh diet.

VI. TABLE SHOWING THE OCCURRENCE OF CYSTS IN BUTTERFISH

The last tables showing the results of the examination of butterfish for flesh parasites which I have published included the results of the investigation of the summer of 1908.

Following is a similar tabulated statement for the years 1909, 1910, 1911 and 1912 to the date of writing, August 19.

Year	Number of fish examined	Length of fish in centimeters	CYSTS SEEN					
			Very numerous	Numerous	Many	Few	Very few	None
1909	279	20 and over	118	28	27	29	54	23
	134	15 to 20	51	16	18	17	14	18
	43	10 to 15	2	4	9	3	13	12
1910	306	20 and over	51	34	32	36	79	74
	102	15 to 20	14	18	11	13	18	28
	8	10 to 15					1	7
1911	183	20 and over	19	26	28	19	36	55
	154	15 to 20	31	19	37	30	13	24
	65	10 to 15	10	8	9	15	16	7
	273	Less than 10	66	66	78	36	24	3
1912	298	20 and over	35	45	34	38	66	80
	175	15 to 20	22	13	13	28	34	65
	258	10 to 15	13	17	11	29	46	139
	217	Less than 10				1	2	214

The result of the examination of small butterfish in the year 1911 appears to be exceptional. In other years I have found the small butterfish to be but sparingly infected.

On September 15, 1911, I examined a lot of 223 butterfish ranging in length from 68 to 100 millimeters, and made the following record of cysts found: Very numerous, 63; numerous, 54; many, 62; few, 24; very few 19.

It is an interesting fact that the butterfish in the Woods Hole region that are taken late in the season show a higher percentage of infection than is shown by those taken earlier in the season.

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FEDERAL CONTROL OVER FISH IN BOUNDARY WATERS

By Henry Hinrichs, Jr.

I realize that the time of this convention is limited, and that other questions of an importance equal to that which attaches to my subject are to be discussed. I shall therefore be brief in my treatment of the topic selected.

The majority of those engaged in commercial fishing are not free from the temptation to obtain possession of as much of the world's goods today as is possible, with utter disregard for what becomes of tomorrow. This desire for wealth, characteristic of the human race, unchecked by absence of wise laws or the failure to enforce the same when enacted, results in a wholesale destruction of an almost incalculable number of small, immature fish. Unless one has witnessed the landing of hauls of fish from ponds and trap-nets in the spring of the year, the enormity of the waste so incurred cannot be fully realized. It is no uncommon thing to see from ten to twenty tons of small pike, perch, bass, and herring, each fish averaging less than $\frac{1}{4}$ lb. (where the average size of mature pike and herring is $\frac{3}{4}$ to 1 lb.) brought into one port alone daily for a month or more each spring. A goodly proportion of these, on account of their extremely small size, are taken to the fertilizer plant. No matter how much money the Government may expend on the propagation of food fishes, the depletion of the commercial food fishes can only be temporarily deferred unless some drastic measure in the line of rules and regulations governing fishing be adopted. A continuation of the present policy will mean that, inasmuch as the fish are not given a chance to reach a state of maturity, it is only a question of time before it will be next to impossible for the fish culturist to obtain a sufficient supply of mature spawn to warrant the operation of fish hatcheries.

I cite the case of our local hatchery, the superintendent of which was unable to procure more than one-third of the ordinary quantity of mature pike spawn, due to the complete failure of catches of mature pike for four successive seasons. It is absolutely useless, it appears to me, to expend any money on the gathering and hatching of the spawn and to incur the expense of shipping and liberating the small fry when anyone who so desires may fish whenever or wherever and with any kind of a device he pleases. It seems to me that there ought to be an opportunity for every fish to reproduce its own kind, either by natural deposit of its spawn or by enabling the fish culturist to obtain the spawn and hatch the same artificially. Any device purposely created for the catching of these small, immature fish, or the use of any kind of a net with meshes insufficiently large to permit the escape of the small, immature fish, should be prohibited.

The fishing laws placed upon the statute books of the different states bear witness that it has been realized that some one must exercise some control over the commercial fisheries in order that not only the present consumers but those of the future may be protected. Some states have excellent laws, which, if enforced, would in a large measure lessen the waste; but one giving more than cursory attention to the fishing laws realizes that but very few efforts at enforcement are attempted. This failure to enforce these laws is due presumably to the lack of uniformity in the laws of the different states bordering on the same body of water. One cannot help but admit that it would be a grave injustice to the fishermen of Pennsylvania, for instance, to prohibit them from using a certain destructive device, when his neighbors in the adjoining state of Ohio are permitted to make use of the same.

The failures of numerous attempts in the past to have uniformity in the fishing laws in those states and provinces bordering on Lake Erie are proof of the futility of further efforts in that direction.

The average person engaged in fishing or handling of fish will consider any measure tending to regulate the fishing as inimical to his interest and any candidate for office inclined to favor regulations will not receive the interested one's support at the polls. It can readily be seen that in a community where fishing is one of the leading industries no one favoring the discontinuance of the present destructive methods of fishing will be elected to represent the district in the legislature.

While this same condition confronting a candidate for the state legislature confronts the candidate for Congress, nevertheless the part of the constituency interested in fishing is proportionally much smaller in a congressional district than in a legislative division, therefore a candidate for Congress would not be so apt to be pledged to fight against measures for the benefit of conservation as the candidate for the legislature would be. Furthermore, the federal authorities are inclined to be more strict in the enforcement of the federal laws than the state authorities seem to be with the laws of the state.

Authorities on constitutional law contend that the federal government has a right to regulate the fishing in the boundary waters. In pursuance of such right, a commission was appointed a few years ago for the purpose of investigating and studying the fishing from the Atlantic to the Pacific in order to be able to draft and submit to Congress rules and regulations, the adoption of which would inure to the benefit of both producer and consumer, (1) by preventing the continued indiscriminate destruction of immature fish, and (2) by limiting the number of nets to be fished at one time by any boat to cause the production of a fresher and more wholesome article of food. These rules and regulations, drafted after a thorough and unbiased investigation by the International Commission, comprised of eminent authorities on fish and fish life, have not become laws. Those selfishly interested got the ear of the "near statesmen" at Washington, and through them caused the emasculation of the bill to such an extent that the enactment into law of the amended form would have been an insult to anyone of average intelligence. The original bill was not permitted to become a law for the reason that there was not a strong advocate battling for the people's rights nor anyone interested who could have aroused the necessary public sentiment.

Today we are as far from the solution of this important problem as ever. Ingenious devices for the catching of the small fish are used in increased numbers, the number of small fish taken annually increases with them, and the number of mature fish caught decreases proportionately. As long as those interested in the fishing industry are permitted to judge for themselves as to what is right and what is wrong, just so long will such conditions as now exist continue. There is only one way, it seems to me, by which this tremendous waste may be stopped, namely, as before suggested, by the federal government's assuming control over the fishing in boundary waters, thereby so conserving these valuable natural resources that not only we may enjoy a plentiful supply of wholesome food fishes, but that like benefit may be in store for those who are to follow us.

No one realizes more clearly than myself the tremendous benefit of artificial methods of propagating fish, but I believe that I do not err when I state that as equally important as the artificial propagation of fish is the wise regulation of the catching of the same. I believe that efforts exerted along these lines are in the right direction and therefore take the liberty to suggest that a committee be appointed by the American Fisheries Society to investigate the present condition of commercial fishing on the Great Lakes, and to submit a report of such investigation at the next annual meeting.

RECENT LEGISLATION AFFECTING THE FUR SEAL

By C. H. Townsend

The Sixty-second Congress, in passing the bill to give effect to the treaty between the United States, Great Britain, Russia and Japan, for the suppression of pelagic sealing, attached an amendment providing for a closed season of five years on male seals on the Pribilof Islands.

This endangers the treaty, as it cuts off for five years the percentage of profits to which the other countries are entitled by the provisions of the treaty. It will result in too many fighting males and a consequent loss of pup seals by trampling. It will also mean a loss of over two and a half millions of dollars to the Treasury in five years, as the skins of old males are of no value. It will destroy the most valuable herd of blue foxes in the world, the large size of the fox herd being dependent upon the abundant food supply of the seal killing grounds. The fox fur resources are worth almost as much as is the seal at the present time.

The amendment was against the recommendations of the Bureau of Fisheries, and also against the advice of all the American and British naturalists who have studied the fur seals on the Pribilof Islands.

The outside sealing interests have always been represented at Washington by an active lobby. This lobby has been discredited and defeated several times in the past, and could not have won in the present case without the very active help of certain respectable persons, who no doubt mean well, but not one of whom had ever been on the Pribilofs or understood the peculiar nature of the fur seal. These gentlemen failed to perceive that they were being used to further the future exploitation of the seals by private interests. It created considerable political disturbance, chiefly by assailing the reputations of men connected with the fur seal service. A future move of the seal lobby, when the critical moment arrives, will be to propose a return to the old method of having the killing done by lessees, instead of by the government.

Among other charges the charge was made that the Bureau of Fisheries had been killing *pup* seals. A part of the annual catch made on the Pribilof Islands was classified in the printed catalogue of London sales as "pups," "small pups," and "extra small pups." It was shown by officers of the Bureau that these terms, long used in the fur trade, did not mean either yearlings, gray pups or new-born pups, and skins duly certified by furriers as "*pups,*" "*small pups,*" and "*extra small pups*" were shown to the House Committee. They were actually skins of various sizes of two and three-years-olds. In spite of the facts presented, the baseless outcry of the seal lobby against "pup killing" won out.

The surplus males of the polygamous fur seal have long been killed on the Pribilofs, because they were actually a *surplus,* not required for breeding purposes. The outcry against "pup killing," even if there had been such killing, is utterly senseless. If the skins of a lot of bull calves should be found to be worth as much as could be realized from the sale of an equal number of full grown steers, would any stock breeder think of raising them?

The *age* at which surplus males of either seals or cattle are killed does not matter so long as they are disposed of when most profitable, provided sufficient males are saved for breeding.

Very fortunately for the fur seal, the ten-year closed season proposed by the seal lobby fell through. Although Congress had no clear understanding of the fur seal situation, it *could* understand that a ten-year closed season on males would mean the loss to the Treasury in ten years of fifteen millions of dollars. Just what will be done later on to rid the breeding grounds of their hordes of big fighting bulls remains to be seen. The saving of the entire stock of males is against all biological experience. No breeder of polygamous animals does anything of the sort.

The wastefulness resulting from this vicious amendment is not really as serious as its intent to fix responsibility for the condition of the herd *upon the Government*, instead of on the pelagic sealers, who prey upon the female portion of the herd, and who alone are responsible for its present reduced condition.

DISCUSSION

Prof. L. L. Dyche, Kansas: I do not know as I can add anything to this excellent paper. It gives me pleasure to endorse everything Mr. Townsend has said in his discussion of the subject. I was in Washington and appeared before a Senate Committee and some members of Congress and expressed myself in rather vigorous terms along lines so splendidly set forth in this paper. It is hard to understand why Congress could not be made to understand the real and true condition of the fur seal situation as presented by scientific men and naturalists who have given years to the study of the problem. About the only way it can be accounted for is that certain parties have spent a great deal of time in lobbying with members and misrepresenting the real situation and the real conditions on the Pribilof Islands.

I have spent several months on the coast of Alaska and have some knowledge of the fur seals, and I think I understand the situation as naturalists understand it who have been up there and studied it for years. When it comes to getting a law passed in favor of the seal industry and in favor of conditions that would promote the welfare of the seals themselves and that would save a great amount of money to our own Government and be fair to other governments concerned, and be absolutely fair to all conditions of seal life, it seems almost impossible to make Congress comprehend the situation. This seemed to be especially the situation during the session of Congress last spring. The mixed condition of things at that time seemed to have been brought about by a heavy lobby against the real interests of the seal herd and the real financial interests of this country. It was freely rumored at Washington that certain interests with ulterior and selfish motives were figuring against the interests of the seal herd and the interests of the Government, and were working for the passage of this bill. It would seem that there are certain parties formerly engaged in certain kinds of seal business who have hopes of getting and keeping a loose-jointed law on the books that would permit of a loose-jointed business being carried on in the "seal fisheries." A law would suit them that would make it possible to stir up some sort of feeling with England or Japan that would lead to pelagic sealing in one form or another. Such a condition of things would favor certain parties and certain interests. Some hidden influences of such character and nature might be found if one should look in the right place that would explain a condition of things that makes it almost impossible to get a law passed that would adequately and fairly protect both the seals and the seal interests.

President: I think that is a good suggestion and I hope every member will go to his respective state and try to influence his member.

Professor Ward: Unfortunately this is an act on our statute books passed against the unanimous testimony of a Board of Experts and the unqualified opposition of the Scientific Department of the Bureau of Fisheries, having naturally a general relation to this matter.

It is still more unfortunate, and I think I may say from a scientific standpoint, absurd, situation, to consider that the Senate proposition was pushed by Senator Hitchcock, of Nebraska, a man who represents one of the greatest cattle-raising states in the Union, who advocates a principle which would destroy the stock industry, which is as unscientific and as unthinkable on the part of any man familiar with the raising of cattle or sheep or chickens, as anything possible could be. And I think it is time for this body, representing the entire sentiment of the entire country in the field of fisheries, to protest against the action of the Congress of the United States, when that action is determined, not by scientific principles, but by something else, which we have no official reason to recognize, but which we cannot help recognizing as being entirely unscientific.

Mr. Seymour Bower, Detroit: Believing as I do that Dr. Townsend has stated the facts in the case, I move that the Resolutions Committee be directed to prepare a resolution protesting against the action of Congress and recommending the repeal of this obnoxious feature of the law.

Motion seconded.

President: I expect from Dr. Ward's talk that the resolution is already prepared.

Dr. Field: As a practical matter there is only one way to bring this subject forcibly to the attention of Congress, and that is to have every member of the Society, so far as possible, put the matter directly up to his senator and representative, and state that he and his friends are personally interested; and in that way some sentiment can be developed in Congress.

THE KANSAS FISH LAW

By L. L. Dyche

The last legislature passed practically a new law to govern the fishing interests in the state of Kansas. This law contains a number of new features. However, the intent and purpose of the law is to protect and increase the supply of fish in the ponds, lakes, and streams of Kansas.

One of the features of the law not well understood is the provision that only one hook can be used on a line. The object of this clause in the law was to prevent catching fish with a bunch of hooks tied on a line and used as a snag or grab hook. When the water is cold, and especially when it is covered with ice, it frequently happens that the fish bed in deep water beside an old log or in some other convenient place. This makes it possible for certain persons with a bunch of hooks on the end of a line, to drop the hooks into such schools of fish and to snag the fish by giving the hooks a quick jerk. Great numbers of fish are sometimes taken in this way. Many cases have been reported where fish have been taken below a dam, or other favored place where fish naturally congregate, by the use of grab hooks or snag hooks.

There could really be no objection to fishing in the old-fashioned way, with two or three hooks on a line. It is hard to frame a law that will prevent using three or four hooks on a line as grab hooks and at the same time allow a person to fish in a proper way with three or four hooks on a line. However, twenty-five hooks may be used on a trot-line provided they are a reasonable distance apart and used in a stream as a trot-line. Most sportsmen use but one hook on a line and prefer this method of fishing to using three or four. The law does not prevent using several lines, each with one hook on it.

Another feature of this new fish law provides that any citizen of the state of Kansas who gives a fifty dollar bond may obtain a permit from the Fish and Game Warden to own and use, during certain seasons of the year and under certain prescribed conditions, a seine with meshes three inches square. This law makes it possible for any citizen to own and use a seine. The idea of a three-inch-mesh seine is that fish weighing from three pounds upwards may be caught. After fish reach this size, it is proper that they should be caught and used for food. Many of the larger fish, such as the buffalo and the carp, rarely take a hook, and when they do they are hard to handle and land successfully. By the use of a seine they can be taken more readily, and lawfully.

A seine with meshes three inches square makes it possible for the young fish and fish up to three pounds in weight to pass through its meshes, and as most fish spawn at least once by the time they reach the weight of three pounds, this provision of the law guarantees a continual supply of fish in the streams. It seems to us a wise provision of the law that protects the young and undersized fish from being seined until they can spawn at least once.

After the fish, especially such varieties as carp and buffalo, have reached a weight greater than three pounds, it seems not only proper, but advisable, to allow them to be caught by use of a seine and used for food.

At first certain parties were inclined to make light of this provision of the law, but the number of letters received from persons who have used these seines indicate that they are pleased, and they pronounce the law a good one, as it works for the benefit of both the fish and the fishermen. One correspondent wrote that the farmers in his locality were pleased with the law. He said: "The farmers do not have time to fish with hook and line and when they do they seldom catch anything." "This law," he continues, "makes it possible for the farmers to get fish without violating the law."

GRAYLING

By H. D. Dean

I am informed that there were originally no grayling on the west side of the mountains in Montana. I believe this is true. Three years ago grayling were planted in Georgetown Lake, west of Anaconda and 20 miles distant. It is an artificial lake of 2,600 acres, and I have been told that grayling weighing three pounds have since been caught in that lake. I have seen many that weighed two pounds. Eggs have been taken from them for two seasons now. The fish are there, very plump and fat, and larger than any that are in the native waters on the east side of the mountains. There are, as far as I know, no grayling on the east side of the mountains that approach the size of those in this lake, even at the age of three years. I believe grayling can be reared successfully in any lake that has minute food for the young.

I believe most of you are aware that the eggs of the grayling are first placed in jars, and that they are left there until they are well eyed. Then the eggs are taken from the jar and placed on trays, where they are kept until they are hatched. Our experience this past season indicated that the period just before hatching was the only dangerous one, as they may smother at that time, but I believe this difficulty may be overcome.

After they are hatched they go to the bottom of the trough and stay four or five days. Then the fish begin to swim up in the water a little like the whitefish does. At this period they may be transported with safety. We took a can of them last spring when I thought I was going to Georgetown Lake next day, but something happened to prevent the trip. We had put up 3,000 fish in a can, which was very thin, of course, for fish of that size; but that can of grayling remained four or five days in the hatchery before it was taken out. We had to have room, and so we put them in the can, and we did not do a thing to the fish during that time except that we let a siphon hose run on the outside of the can to maintain the proper temperature.

Grayling, as you know, were found originally in the upper waters of the Missouri, in the Madison, Jefferson, and Gallatin Rivers, and in their tributaries. I believe those are the only waters in the state where grayling were found.

This year we took 100,000 grayling to a lake 5 or 6 miles long and 2 miles wide. This lake contained some of the largest native trout I ever saw, some of them weighing 18 pounds. The size of the trout showed conclusively that there was a large amount of food in the lake, and I thought it would be a good place in which to plant grayling. In two years some results ought to be apparent from the plant made this year.

I think you should plant grayling in small lakes, or else in a river that has large pools. I believe that Twin Lakes in this state, or a small lake like the one near the Leadville hatchery is all right. I believe if you put your little fish in there in two years you will have fish that you can take eggs from.

I do not know that I have anything more to say, unless some one has some questions on the subject to ask. It is easy for me to say I do not know when such is the case, as I have been in the work such a short time.

DISCUSSION

Mr. S. E. Land, Colorado: What was Dr. Henshall's experience with the Montana grayling at Bozeman? Did he hatch them out and handle them successfully, or approve of the distribution of them?

Mr. Dean: I cannot tell. I do not know of any waters that Dr. Henshall put the grayling in that ever amounted to anything.

Mr. D. C. Beaman: This grayling question is a matter of considable interest on account of the generally conceived opinion that they cannot be artificially reproduced. We have a fish culturist in Colorado, Mr. Hasselkus, of Creede, who is one of our best fish culturists; I hoped he would be here today. He tells me that this summer he got 50,000 grayling fry from Montana, and planted them in a lake in southwestern Colorado. They are now, as I remember, about an inch and a half long. I mention this merely that the subject may be brought up at the next meeting, by which time he will be able to tell us how those fish have got along, more as a foundation for future investigation, to see how they will get along in a lake, than anything else. My idea was that they ought to be in a stream, but from what my friend says it does not seem to be essential, and it is to be hoped that we can prove in time that grayling can be raised in lakes successfully.

Mr. C. K. Cranston, Pendleton, Ore.: I want to ask Mr. Dean what method of procedure is necessary, or what opportunity or chance there will be of making purchase or exchange of eyed eggs or fry best adapted for transportation to Oregon. We have a number of lakes which I think will be well adapted to stocking with grayling. I have always heard of the fish and if practicable I would like to get some.

Mr. James Nevin, Madison, Wis.: Several years ago they were planted in the Brule River, and quite a number of them have been caught there. I have not heard for the last couple of years, but I met parties from the Brule three years ago at Madison, and they said there were quite a number of the fish in that river.

Mr. C. W. Willard, Rhode Island: Ten years ago I obtained 20,000 eyed eggs from the station at Montana. They arrived in good condition and we hatched out at least 90 per cent of them; but after hatching we found it utterly impossible to find any kind of food that they would eat. We had the fish in pure artesian water. I believe that had we put the fish upon hatching into the creek water that we might have had some measure of success. As it was, in a very short time our little grayling were all eyes and head and finally died of starvation.

Mr. Cranston: What is Mr. Dean's experience on the subject of shipping and the possibilities of our getting eggs or fry and being successful with them in Oregon?

Mr. Dean: The only place in Montana that eggs have ever been taken that I know of is the upper waters of the Red Rock and within two years at Georgetown Lake.

Mr. Cranston: Have you any surplus that you could dispose of?

Mr. Dean: I cannot tell in advance. This season we took about a million eggs. The Government has a field station at the upper waters of the Red Rock and all the grayling distributed anywhere have come from there. All Montana grayling have come from Upper Red Rock. They have to be sent by wagon 45 miles and then shipped by express. Another difficulty in shipping the grayling is that they must be kept very cold.

Mr. Cranston: A case containing a quarter of a million of eggs would be of comparatively small bulk?

Mr. Dean: Yes, the eggs run a little larger than whitefish—700 or 800 to the ounce; and the Government usually only sends about 25,000 to 50,000 to an applicant; although a year ago last spring, when I had the Bozeman station, we had a little better year and had two and a half million eggs and could have doubled the quantities; but owing to the difficulty of getting word to the sub-station in time, it was not done, and only about 250,000 were shipped out altogether; and all the rest of the eggs were hatched and fry planted in the natural waters there.

The Red Rock Lakes and the little streams where they catch the spawning grayling are about 7,000 feet above sea level. I think the Georgetown lake has an elevation of 6,000 to 7,000 feet.

MR. CRANSTON: What is the temperature of the water on an average?

MR. DEAN: I have not taken the temperature of the water in Georgetown Lake, but it is an artificial lake and not excessively cold.

MR. CRANSTON: And they thrive there, do they?

MR. DEAN: Oh, my, yes. That is the finest place in the world for them, and they are the finest fish I ever saw.

MR. CRANSTON: There is no doubt but they would do well?

MR. DEAN: They will stand much warmer temperature than the trout and will carry much better when small than trout.

MR. CRANSTON: That is, the fry after being hatched?

MR. DEAN: Yes—4 or 5 days after hatching when they begin to swim out.

MR. CRANSTON: How about the difficulty of feeding which has been mentioned?

MR. DEAN: I would not want to try it, unless you can run creek water to them. Dr. Henshall did have a little success in feeding by using water from a creek.

MR. CRANSTON: Your method is to liberate them as soon as they swim up and seek food.

MR. DEAN: Yes, same as whitefish. We will have some nice specimens at the Helena Fair and we can show you grayling from this lake that weigh over two pounds each, and we will have them on exhibition at that fair.

MR. G. H. THOMSON, Colorado: How do the grayling and trout do in the same stream?

MR. DEAN: Near the Madison power dam for a distance of 4 or 5 miles in length and a mile in width, on the Madison River, which heads away up in the National Park and comes down and helps form the Missouri at Three Forks, there are the grayling, the brook trout, steelheads and rainbows living together. Steelheads have been caught weighing over 12 pounds. They all do well. In Georgetown Lake natives, brook and grayling live together in peace and harmony, and are growing fast.

MR. THOMSON: On this proposition of the grayling I would like to say that up in the northern portion of Colorado there is a portion of the river above Fort Collins, above which, on account of the large dam used for irrigating purposes, our trout are not able to go, where the Fort Collins Game and Fish Association have planted grayling; and they are trying it out, but I cannot say what the result will be.

MR. SEYMOUR BOWER, Michigan: Where were these fish taken from which you secured the eggs? Were they taken for spawning purposes and directly from this artificial lake or from tributary streams?

MR. DEAN: This artificial lake was made there because of two large springs—one the lake water covers; and the other spring is quite large, the flow being probably 5,000 gallons a minute; and it was in this stream that we had our trap 300 yards, perhaps, from the lake.

MR. WILLARD: I was told by some member of the association that he knew of a party in Colorado who had successfully introduced the grayling and that grayling were being caught in the waters in which he introduced them, of good size. I wonder if that gentleman is present?

MR. D. C. BEAMAN, Denver: I never heard of him.

MR. CRANSTON: I will say for the information of the last speaker that our Williamson whitefish is erroneously called grayling by many people in Oregon; and I have known it to be distributed as grayling. The outside appearance is similar and in western Oregon it has been called grayling for many years.

MR. LAND: That is the same case in Colorado and Wyoming. There are certain streams where these whitefish are found and they are classed as grayling by the novice; but according to Dr. Jordan they are the Williamson whitefish or the Rocky Mountain whitefish. Now, these Montana grayling, I agree with Mr. Dean, cannot be raised and fed; but they can be raised and liberated, and if out in lakes such as Judge Beaman mentions or Mr. Dean speaks of, they can be successfully propagated and distributed through other streams that are suitable. The streams where we find the Rocky Mountain whitefish are streams that have pools, and are not too rapid. We have several of these streams in our state and in Wyoming, and those are suitable for the life of the grayling. The grayling of Montana will grow in streams wherever we find the Rocky Mountain whitefish. The grayling in Montana was first discovered in the head waters of the Madison River, and *Thymallus montanus* is the scientific name for them. The only grayling known in Michigan is *Thymallus tricolor*, which inhabit the Manistee and Au Sable Rivers, found especially in pools. The other graylings reported by Dr. Jordan are found in Alaska and are known as *Thymallus signifer*. They have a much larger sized fin than any of the other. They can be successfully raised if planted as soon as hatched, but do not undertake to feed them.

MR. BOWER: In regard to the planting of the fry, do you place the fry in the streams in which they attempt to spawn, approximately, near the spawning grounds, or do you scatter them throughout the lake, and, if so, in what depth of water; what are the general methods of planting?

Mr. Dean: Most of the original plants were made in this little creek. We put them in both places this year; but I prefer putting them along the lake in the shallow water. At the time the grayling was put out this shallow water was not very warm—probably 45° perhaps; and there is plenty of food all along this Georgetown Lake,—especially the fresh water shrimp, which are thick in all the shallow water. The land around the lake was originally flats and almost marshy. Now, there are lots of places all around which are rather marshy. You cannot get out to the clear water in some of the places around the shores without boats.

Mr. Cranston: Is there a central very deep part of this lake?

Mr. Dean: Probably, it is about 30' to 40' deep at the dam.

Mr. Cranston: Most of our natural lakes are extremely deep, and the proportion of shallow waters around the edges is rather small; some are exceedingly deep and suitable for grayling.

Mr. Dean: I think it is largely a question of food. If there is food in the lake the grayling will do well.

President: I want to add my testimony in regard to replanting grayling. Mr. Nevin put grayling in the Brule River in Wisconsin, where there was never any before. I was with Judge Robinson two years ago and hooked a grayling, and I said, "My God, that is a grayling!" Judge Robinson said, "No, there is not a grayling in this river." But almost before the fish was landed I had another one. But those were the only two we caught, and we fished several days. But I know the Brule has got grayling there. They were planted by Mr. Nevin and the eggs came from Montana.

REPORT ON PROGRESS IN THE CONSTRUCTION OF THE NEW POND-FISH HATCHERY IN KANSAS

By L. L. Dyche

The contract for building the new and improved fish hatchery, at Pratt, Kan., was let to James R. Green & Company, Ltd., of Chicago, September 21, 1911. The following include the chief items in the construction of this hatchery, namely:

A concrete dam 500 feet in length, with an earth embankment extension of 200 feet built over piling. A concrete intake chamber with bronze and iron gates and other appurtenances for controlling the water. A water supply conduit of 21-inch vitrified clay pipe, 6,875 in length, with manholes and other structures. Approximately 147,000 cubic yards of levee embankment. Approximately 1,000 feet of 12-inch, 6,000 feet of 10-inch, and 15,000 of 8-inch vitrified clay pipe laid in trenches from 3 to 11 feet in depth.

There are 105 concrete structures and water transmitters with 197 bronze and iron sluice gates, mostly 8-inch, and five cast iron flood gates. There are 350 wire mesh screens 30x36 inches. These screens were made by fastening wire mesh screening by the use of copper wire on frames made of ¾ inch standard galvanized steel pipe.

The 83 new ponds now being added to the eleven in the old hatchery will make 94 available for immediate use. Plans are drawn for the addition of 17 more ponds. These ponds extend over a strip of ground one-quarter mile wide, and one mile in length. They will average about one acre each in surface area and will furnish something like 15 miles of shore line for old fish to breed on, and young fish to feed on.

The contract time for finishing this part of the hatchery was October 16, 1912, and it was finished and turned over to the state November 21, 1912.

Plans have been prepared and approved for the construction of twenty-two buildings on the hatchery grounds. They will include a fish and game building with an aquarium addition; six residences and cottages for assistants and caretakers on the hatchery grounds, and other such buildings as a power house, barn, and tool houses needed for hatchery purposes.

WATER POLLUTION AND OTHER NOTES

By Joseph H. Acklen

It is indeed an honor to address this body of men, a Society that has a proud record of nearly half a century behind it. Well could you rest upon the laurels which you have already won in the field of the propagation and protection of fish in this great country, but there is still a greater future before you. Conditions existing at the time of your organization 42 years ago have greatly changed in this country. Our population in that length of time has doubled. Intensive farming and manufacturing industries present for the men who are interested in the propagation and preservation of fish questions that have never heretofore arisen.

Your association and that of the game and fish commissioners are closely allied. They should work in thorough harmony, each assisting the other. The most serious question that you gentlemen have to face, and one in which there may be a little friction in some states, is where there are separate commissioners for fish and game. Where they are under one jurisdiction that difficulty does not arise. Therefore the need and necessity of harmony is all the more apparent, if success is to be attained.

The most serious proposition for the future is the question of what is to become of the fish that you gentlemen are raising, the output of your hatcheries, and that question is to be solved by some legislative restriction upon the pollution of our waters. Measures to prevent such pollution are frequently combated in different legislatures by manufacturing industries, and by municipalities which are not willing to see that their sewage is properly disposed of. I believe I could not do better than give you my views as I expressed them on a former occasion. "The pollution of public waters is our most common act and our most uncivilized practice. The casting of refuse in a stream results only in transferring it from one neighborhood to another." From every point of view the matter should have consideration. There can be no doubt that, as a means of breeding disease it is one of the most productive. If there were no other means than the use of rivers and brooks to care for sewage and chemicals from factories, it would be a different proposition, but with modern septic devices that will care for it and do it well, there would seem no reason why proper legislation should not be had. Water which is foul enough to kill fish should be warning enough to localities that serious consequences would follow in other directions.

"The decrease in the supply of food fishes is traceable more to the pollution of waters than to any other cause, and stream pollution is going on at a rate proportionate to the increase in population and the development of manufacturing industries. The pollution of streams not only affects fishing for sport and commercial fishing, but the all important matter of the public health.

"The agencies at work are almost too varied for enumeration. In general, the pollution of water is caused by sawmills, pulp and paper mills, tanneries, starch, cheese, and sugar factories; gas, wood alcohol, chemical, glass, and dye works; oil refineries, distilleries, and breweries; logging, smelting, and mining; and by factories of all sorts. To this catalogue might be added the item of dead animals, which in the aggregate is an important one.

"There is hope for the early salvation of our mountain streams where the population is not yet sufficient to cause damage by sewage. Here we have to deal chiefly with such matters as pollution by sawdust and wood-pulp refuse.

"Recent experiments have shown that sawdust promotes the growth of fungus on fish eggs and kills both eggs and young fishes. The finer kinds of sawdust affects the larger fishes, getting into their gills, and dead fishes are found with considerable sawdust in their stomachs. Paper and pulp mills use lime, caustic soda, sulphuric acid, etc., all of which are deadly to fish life, when drained into streams.

"In spite of the fact that there are laws which prohibit the drainage of dangerous matter into public waters, there exists in factories without number secret waste pipes which are opened during the night, the outpourings of which are so deadly to fish life that the practice of operating them can only be named as dastardly.

"We have lived under these conditions so long that we are used to them. It is the old case of each for himself, with no thought of the health, wealth, or happiness of those farther down stream. In many beautiful streams, where fishing is still possible, fishes have become uneatable through tainting of their flesh.

"Sawdust can be kept out of streams, and at a very moderate expense. The wastes of mills can be kept on land and evaporated or otherwise treated. Water containing deleterious substances of all kinds can be settled, cleared, filtered, evaporated or purified by chemical processes. It is needless at the present time to argue against this point, since engineers everywhere understand methods of disposal suitable to various conditions. It is not only possible to keep wastes out of the water, but it is possible to turn them into profit through valuable by-products. In many parts of Europe sewage is not only kept out of the water, but valued as fertilizer."

At each session of the Tennessee Legislature since 1903 I have urged the enactment of a law to prohibit the pollution of our streams, the bill on this subject having been carefully prepared in accordance with like laws of other states, where the subject is no longer a matter of experiment. The opposition of mill and mine owners and certain manufacturers has, however, proven effective in defeating it.

These, in brief, are some of the views I have heretofore expressed on this subject; but there is one thing we must bear in mind,—we cannot secure results without the creation of a proper public sentiment. Back of all law there must be public sentiment, if that law is to be enforced; and one of the highest duties that we owe to the people of this country, in view of the constantly increasing demands for fish as a food supply, due to the increasing cost of living, is to create and foster that sentiment.

In the south, and notably also in the west, the laboring classes are prone to eat too much hog meat. Hog and hominy are all right in moderation, but hog and hominy as an exclusive diet is very hurtful. Physicians have told me that the best antidote to an excess diet of pork is fish food; that if a man eats pork seven days of the week, he is likely to be sick; but if he can substitute fish food for two days out of the seven he can retain his health. Can there be any greater benefit conferred upon the public, upon the citizens of this great country, than the promotion and upbuilding of the public health. It is said that a laboring man is worth some $900 per annum for his mere labor; he is an asset if he is healthy; but if he is unhealthy he is not only a drawback to the community, but he is a burden to it.

Let us therefore from all these standpoints proceed with this work, and, Gentlemen, this Society is building to itself a monument which the future citizens of this country will point to with pride.

THE OYSTER AND FISH INDUSTRY OF LOUISIANA

By W. O. Hart

The oyster beds, still in almost their primitive state, form one of the principal resources of Louisiana, inasmuch as the oysters raised along the coast, and prepared in local factories, are one of the largest exports of the state. The oyster fisheries lie principally in St. Bernard, Plaquemines, Jefferson, Lafourche, Terrebonne, Vermilion, St. Mary, Iberia and Cameron Parishes (a parish in our state corresponding to counties in other states), and constitute an area of approximately 471,961 acres, on which there are 1,762 leases, covering 17,072.94 acres. The remaining area, while it is not under lease, is reported to be in every way susceptible to cultivation, and the grounds have been found to be some of the best producers in the country.

Therefore, while at the present time the oyster industry in Louisiana will compare favorably with any of the fisheries in the United States, it is believed to be as yet in its infancy.

The cheapness of the leases and the easy conditions under which the trade can be entered make an attractive offer to anyone so inclined, and is inducing many to take up the lucrative work. The lands aggregate an annual lease rental of $1 per acre and at present there are approximately 453,888 acres of productive bottoms to be chosen from.

Already engaged in the business, according to the leases granted by the Board of Control, are 1,762 fishermen, who find a ready market for their products among the local canneries and shucking plants. These canneries and shucking establishments supply nearly all of Texas—80 per cent it has been estimated—and all of Louisiana, besides a large wholesale trade in the North and East.

Of the leased acreage all has been tried and found to be most lucrative, and yet it forms but a minute part of the vast area which is available for oyster culture.

Kindred to the oyster fisheries are the shucking and canning industries, which furnish employment to several thousand families. In the city of New Orleans are located twelve shipping concerns which handle the raw oysters, while over the remainder of the lower coast are scattered fifteen other plants. These plants vary in capacity and output, although the output of each is almost unlimited, the work is conducted on the piece scale, by which the salaries of the employes are governed.

These plants during the season run at full capacity, while in the summer only a very small output for the furnishing of the immediate market is made. These plants are all well established, and during the busy season transients open up smaller plants and enter the field of furnishing the supply for the enormous demand for Southern oysters.

The direct shipping industry occupies an equally prominent position along with the canneries, especially in the winter months, as the fresh oysters for the trade in all the neighboring states are supplied from these plants. They also run on the scale of piece work, and almost unlimited supplies of oysters are shipped out annually.

Throughout the lower part of the state are scattered these plants where the oyster is prepared and shipped throughout the northern states, as well as to the adjoining states. On the lower coast, in the heart of the oyster beds, three of the largest plants thrive with many others at different points. These plants have their own shucking auxiliaries where the oysters are prepared for the kettle and then hermetically sealed in tin cans ranging from half pints to gallons, according to the demands by the trade. Also some of these oysters are shipped in bulk for use in restaurants, hotels and cafés.

Connected with these oyster canneries are also the shrimp departments where the shrimp, another product of the water, is put up in large quantities. The Louisiana shrimp even exceed the oysters in their excellence and renown throughout the country, being universally used in all markets where they can be supplied by the local canneries. A feature of the oyster and shrimp canneries is the fact that there is practically no waste labor for which the operators of the factories have to pay.

The old-established custom of paying for only what they receive is the vogue in these plants, and for shucked oysters so much per pound for the raw material is paid to the shuckers, while the fishermen are paid in proportion to their catch.

VARIETIES OF OYSTERS

Nestling in the bottoms around Ship Island are found what are considered to be some of the best oysters in the world. These, together with the plants found in Four Bayou, bear the estimable record of excelling the celebrated blue points gathered along the coast of Long Island. Out on the verge of the Gulf of Mexico, where they are free from any taint that might be included in the river waters, these oysters are gathered and bring the best price on the local market. The Ship Island variety are found in great abundance on the reefs and bottoms surrounding that miniature island, while the Four Bayou variety are comparatively scarce, owing to the current during the tides. In this narrow strip of water during the tides there is a current ranging from ten to twelve miles per hour, which makes it very difficult for the planting and cultivating of this variety. Several attempts have been made, however, to imitate this oyster, and in some instances with fair success.

The Grand Bayou and Bayou Cook oysters, fat, healthy oysters of gigantic size, are also considered among the highest grades of oysters and bring a very good price on the market. These oysters compete favorably with the Ship Island and the Four Bayou varieties in excellence and cleanliness. They are found in abundance in the bayous from which they derive their names and are used in great quantities in Louisiana, Texas and Mississippi, being the chief raw oysters that are shipped to these points.

A small but excellent variety which brings a good price on the local market and scarcely ever is shipped out of New Orleans, never getting farther than the Louisiana line, is the Grand Lake oyster, which is found in comparatively small quantities in Grand Lake, approximately forty miles west of Grand Island in the Barataria Bay. These oysters are found in their primitive state, no effort having been made to any extent to cultivate the bottoms and reefs in this portion of the state.

Besides the finer grades found in the local waters are the Buras, or Supreme Bay oysters, which are gathered in unlimited quantities from Supreme Bay, near the Gulf Coast, on the east side of the river. These oysters are of a cheaper variety and furnished principally to the canning factories and local cheaper trade.

CONSERVATION OF OYSTERS

While there has never been any concerted movement toward the conservation of the local beds of oysters, the fishermen are becoming acquainted with the fact that although there is an almost unlimited supply of oysters, the beds must be conserved if the fishing is to go on indefinitely. To this end the fishermen are working, although the work of arranging the beds properly is hampered, owing to the fact that no aid is being given by the state or federal authorities.

The seed oysters, with which the beds are supplied each year, are gathered from beds on the east side of the Mississippi River about sixty miles below New Orleans. These seeds are transplanted to the beds where the best results have been secured. These beds are now being strewn also with oyster shells. For every barrel of empty shells scattered over the beds by the fishermen, in three years' time three barrels of oysters will be reaped as a harvest.

Dredging also aids greatly in keeping the beds in good shape. Too much dredging would prove fatal to the beds, but under the present conditions the channels are kept clean of refuse, incidentally keeping this from infecting the oyster beds. Continual warfare, however, is always kept up between the dredgers and the fishermen for fear that the dredges will encroach on the oyster preserves and injure the plants. This, however, has very rarely been the case, and the oyster business at the present time is at its height.

THE OYSTER SHIPMENTS

From the local fields the state of Louisiana, Mississippi, Alabama, Oklahoma, Arkansas, Arizona and New Mexico derive almost their entire supply of oysters, while a great quantity of the local catch is shipped to Texas, Tennessee and California, the latter state being provided with only the best oysters that can be afforded by the local market.

The territory which is supplied by the Louisiana oyster is continually broadening, however, and every year brings a greater demand and necessitates more factories and shucking plants in the city and state. In the past fifteen years the oyster industries of Louisiana have broadened out by 60 per cent.

Together with the oyster fisheries come the kindred fisheries of shrimp, they being canned and shipped all over the country. The shrimp fishing, however, is more uncertain than the oyster fishing, being generally governed by weather. Shrimp travel in large schools and cover a vast area in a short time, being found in different places at different times. Although hard to catch at times, they are of an excellence and variety that only Louisiana can offer. Within a mile of where the salt-water shrimp, large and tempting, have been caught are found the smaller, sweeter variety of lake shrimp. These lake shrimp abound in bayous, canals and lakes along the southern part of the state, while the salt-water shrimp are generally found in the bays along the uneven coast.

OTHER FISHERIES

There are also to be found in the local waters the celebrated diamond-back terrapins, which, in recent years, have become one of the choicest of delicacies that can be found on the table of an epicure. A large and permanent fishery of these terrapins is located on Grand Island, owned by John Ludwig, Jr., who has been actively engaged in the terrapin industry for the past twenty years.

Redfish and other salt-water species of the finny tribe abound along the local coast and are caught and marketed in great numbers. These, however, are only sidelights of the real fisheries.

Alligators, too, are very plentiful in the bayous and furnish supplies for the California and Hot Springs, Ark., farms, where they are exhibited and where expensive and useful bags and furnishings are made from their skins. One establishment in New Orleans gathered several hundred alligators, ranging from the infants to older ones twelve feet in length. These are crated and shipped like so many cattle and bring a good price in a rather limited market.

THE PRESERVATION OF THE AMERICAN FISH FAUNA

By Henry B. Ward

It is hardly necessary to rehearse before this organization the early history of this country in regard to its treatment of the wild life, and especially the life of its lakes and streams. Not only the first travelers, but the early settlers for a century or more in its history found the waters everywhere teeming with fish of the finest types. There were incalculable numbers of these forms in lake and river and stream and pond. So great was the supply in the markets that the old indentures of apprentices provided that they were not to be fed more than once a week on such magnificent fish as the salmon and sturgeon, which now justly rank as delicacies and sell at prices that preclude their use by unwilling consumers. This ancient abundant supply is all but exhausted; for today the salmon has disappeared entirely from the Connecticut; the sturgeon and shad have become so rare in the Hudson and other rivers that the commercial fisheries have been largely abandoned, and they can hardly be said to belong in fact to our fauna.

Whereas our grandfathers insisted that the fish supplies of these waters were inexhaustible, we have found in fact, and within the limit of a century, that that wonderful supply has entirely disappeared.

Now, the preservation of the commercial fish became naturally a business matter and received as such, early and careful attention. By legal enactment there have been placed limits on the time of fishing, or the amount of the catch, or the size of the catch, limits which should serve to give the poor fish a chance. And when properly enforced these regulations proved helpful, but as population and fisherman multiplied many fold, even all these methods of restriction were soon found to be inadequate to preserve the rapidly diminishing supply of fish, much less to restore that supply to its former abundance.

Efforts were next made to reinforce nature by hatching and planting young fish, and these methods were later coupled with the study of food, habits, and other conditions of existence that surround the life of the fish. A long campaign has been waged along these lines by series of efficient men in the United States Bureau of Fisheries and in the various state boards. It has yielded good results, and yet these results affect only a part of the great problem. The rest is left untouched. To appreciate the full scope of the question that is outlined in the title of this paper one must compare conditions which exist and movements which have been inaugurated in other parts of the field of nature and life.

One of the striking movements of recent years is the formation of wild parks or reserves. Areas have been set aside for the preservation of the native vegetation; state, county and city have laid out park and floral reserve until these areas can be found scattered from the Atlantic to the Pacific coasts in every state and almost in every county of the United States. Game reserves on wild land have been created for the preservation of the native mammals; other places have been set aside that wild birds might carry on their breeding without interference from the hunters.

All these movements have affected merely, or primarily at least, the higher forms of life, the birds and mammals. There is no doubt that the splendid series of bird reserves which has been created by the national Government is an effective aid in the multiplication of species almost extinct, and both Government experts and other workers in scientific fields now confidently proclaim that before many years these species will have re-established themselves in the fauna of the continent.

The problem as it concerns fish life is really much more difficult, because even for migratory birds it is sufficient to set aside a small breeding area and to give them free passage through the air from the points at which they spend one portion of their life to the point at which the breeding process is carried out. For fish it is necessary that a considerable stretch of territory, or even an entire stream, be set aside; and this adds to the expense and difficulties of securing and controlling the area. Yet it may confidently be maintained that such areas will be reserved for the propagation of the native fish and for the preservation of the fish fauna, just as they have been set aside for the preservation of the mammalian fauna and the bird fauna of the continent.

It is not so difficult to provide for the setting aside of short streams. This has been done for centuries in Europe and within recent years in Canada also. In United States territory it has been tried only to a very limited extent; thus in Alaska there are at least two prominent breeding streams of the salmon, which, by appropriate measures of the Government at Washington, have been reserved entirely from salmon fishing and preserved for breeding purposes. In some other places fishing is forbidden or greatly limited in particular lakes or in short streams or small tributaries.

But this is not the main feature of the problem to which I wish to call your especial attention. How do the fish fare on those protected areas which have been set aside for other purposes? What is the condition of aquatic life in the parks that have been reserved in order to preserve the native vegetation, to give breeding places for wild birds, and to furnish a refuge for the large game animals? The answer to this question is unfortunately not as favorable as might have been hoped. It is hardly necessary to call your attention to the fact that stream pollution is increasing; that its relation to these parks and areas is often distinctly unfavorable. Sources of stream pollution originating inside of the areas, serve to reduce, often to destroy, the possibilities for aquatic life in the waters of those areas; and there are numerous instances which have been cited by writers familiar to you all, where such stream pollution originating outside of those areas has served to eliminate almost entirely the possibility of aquatic existence within the area of such a reserve.

Please do not misunderstand me. I would not intimate that in all or even a majority of such parks, especially those under national control, stream pollution has been permitted unreservedly; and yet it takes but very casual attention to ascertain numerous instances where such stream pollution is a real and serious matter. In other words, no adequate vigorous efforts have been made to control this factor, to correct the errors which have been made, or to keep the waters of such reserves favorable places for the breeding of all aquatic life. Surely we may expect that within the limits of national and state parks the water life should receive as careful attention as the life of the land or of the air.

In the next place a careful examination of the conditions prevailing in such areas will show perfectly distinctly that in many cases the fishes and the aquatic life connected with them are the only elements which are not subject to protection. It is possible to catch fish, or to destroy fish life, almost without reserve in some of these protected waters. You cannot pick the flowers, you cannot break the shrubbery or in any way injure the vegetation of the tract, but if you go fishing it is nobody's business; the fish have to look out for themselves!

Not only that, but I have been told on reliable authority that within state parks it is possible at times to see fish which have been caught in considerable numbers, and, not being wanted, have been thrown away to pollute the atmosphere, a senseless waste leading inevitably to the complete destruction of the fish life within those waters.

Finally in this connection I would call your attention to a most important factor: the works of improvement, so-called, which have been carried out in these parks or reserves, have often taken a form which would tend to destroy the native home of aquatic life, and to render the natural breeding and living grounds unsuitable for fish and fish food. In other words, there is a great tendency to do what certain landscape architects call "cleaning up," a process which, when applied to waters, means the destruction of areas of limited depth and shore vegetation, and the modification of the natural surroundings, thus removing the shelter necessary to the development of the fish, as well as the food required for their growth, and often also taking away the available breeding grounds of the fish.

After this brief sketch of existing conditions, permit me to call your attention briefly to the needs of the situation in a definite and somewhat categorical manner.

The country should adopt a more definite policy looking towards the protection of aquatic life, especially the fish on the existing national reserves. The policy should be formulated by those who are the natural advisers of the Government in fish matters, the experts of the Bureau of Fisheries, and put into operation by agents either directly belonging to that bureau or at least approved by them. The evident difficulty suggests itself that some of these reserve areas are under the control of other sections of the Government than the Department of Commerce; but surely it should not be impossible to provide that the men who are made the guardians of those tracts should meet the approval of the United States Bureau of Fisheries as regards their knowledge of the situation and ability to cope with it, in so far as the fish and associated aquatic life are concerned.

In the next place, and more important still, similar action should be taken by all states regarding every state reserve, park or other protected area within its borders and under its control. The water bodies in such places should be preserved as refuges for all kinds of aquatic life, free from all sorts of attack. Stream pollution leading to the destruction of conditions favorable for aquatic life should be rigorously suppressed. It certainly is not too late in the newer states to stop this destruction of the haunts of our native fish, and maintain in a virgin condition the natural environment in some lakes and streams. Already one of the older states has learned the lesson that has been taught by a century or more of disregard for the condition of its streams, and is now attempting to restore natural conditions and to protect the streams from pollution.

In these state areas, definite steps should be taken to protect all kinds of fish found in the waters of these reserves, to give them all possible facilities for living and breeding and multiplying, to safeguard their continued existence and to provide, so far as possible, for their increase in number.

Finally, and most important, perhaps, of all, there should be the definite formation by national and state governments of fish preserves or refuges. These protected areas should provide not only for the commercial fish and their breeding grounds, but also for the other types of fish which are important biologically, are of interest to students of life, and are essential elements in the biological chain of relations that bind the commercial fish themselves back to the environment in which they naturally live. Here each state has its own natural problem. Within its state parks or stream preserves Colorado, for example, should keep the aquatic life of the mountains in its pure condition for future generations. Illinois should maintain in their natural environment the fish of the central prairie region. To Louisiana and Mississippi should be intrusted the duty of preserving the rich and varied fish fauna of the bayous and the brackish waters bordering on the Gulf. Each state and region has naturally some characteristic territory and hence its own proper responsibility in the problem of preserving for the future the varied aquatic life of the continent.

Comments are often made on the rapid and unfortunate disappearance of the game and food fishes as if they were usually the species that suffered most seriously or exclusively from the attacks of the rapacious fisherman or from the insidious influences of stream pollution and of changed conditions in the environment. For commercial reasons the effects on such species are best known, but there is ample evidence to show that they are not the only ones affected. I wonder how many of you know to what extent in some of the older states the small fish, the uncommercial fish of the waters have disappeared. A distinguished biologist, now curator of the Carnegie Museum at Pittsburg, in writing on this problem, says that the small streams of Western Pennsylvania have been almost entirely relieved of their original fish fauna, so that the little fish which formerly swarmed in every pool of their course can now hardly be found at a single point in their entire extent. The natural conditions for fish life are fast disappearing. If the original conditions are to be maintained for the future, even within limited areas, some definite and appropriate action must be taken immediately before everything is gone and aquatic reserves set aside, kept from the encroachment of commercial interests and from other unfavorable influences of increasing population and complexity of human life.

The influence of this Society should be exercised actively to bring about in some way the formation of such reserves. These "fish refuges" should be sometimes the head waters of streams, sometimes stretches in mid-stream, sometimes, let us hope, an entire stream, sometimes perhaps only one of the individual lakes, or cutoffs, or swampy breeding places, or the back waters, or other aquatic conditions which afford a peculiar opportunity for the development of a certain type of fish fauna.

What can this Society do? Various organizations somewhat similar in general character have been successful in developing a series of bird reserves and a series of game parks under national and state auspices. Shall we acknowledge that we are less educated or less influential or less energetic?

DISCUSSION

Dr. F. L. Riser, Henderson, Colo.: Reason and discrimination must be used in the matter of fish protection. The large fish eat the little fish. If we protect the big fish, the little fish will disappear. They have a law here punishing a man for killing a night heron and a blue heron. Yet they are the worst things I have to contend with. Those birds will destroy more fish in a night than I can carry away in a day. Then I think there should be some way of getting the largest fish out of the streams, and giving the young fellows a chance. A large trout will clean up a whole stream in a short time. I think that is one of the enemies of small fish that is sometimes overlooked. Most fishermen will get the little fish, but don't get the big fellows. There ought to be a way of getting the big fish out of the stream.

Mr. C. H. Thomson, Colorado: It seems to me a paper of this kind ought not to lack for somebody to speak upon it. The protection of our fish is one of the serious propositions which we have to contend with, not only the pollution of the streams, but the protection of our streams. Right here in Colorado the kingfisher, an arch enemy of the fish, is a protected bird of plumage.

As we are stocking our streams with small fish, we must not forget the troubles that small fish have with their enemies. Among these enemies are snakes. I could show you, if I had you in my hatchery at Estes Park, three fish over two inches long that I took from a snake's body before it had begun to digest them. The larger fish are living upon the smaller ones; it is the nature of all of our game fish. I took pity upon my pet fish in my hatching trough because I thought it was lonesome. This fish, a brook trout four years old, is so tame that I can take it out of the water with my hand and it will lie very quietly until I place it back into the water again; and I have shown it to 4,500 people. This year, as I say, I took pity on that fish because of its loneliness, and placed a yearling trout seven inches long in the water to keep it company. I had been showing that fish in the morning to tourists at the hatchery, and I showed it again in the afternoon, but instead of exhibiting one fish, I showed my pet fish and the tail of the other sticking out of his mouth, one a three-year-old and the other a year-old, seven inches long; so in the stocking of our streams we should place the small fish where they are best adapted to the stream.

There is another proposition in regard to the protecting of our streams, and that is the protecting our streams from fish depletion by means of our irrigating ditches.

Now, gentlemen, that is a condition which arises in our irrigating districts outside of the eastern districts; our states in the west have that to contend with; and, gentlemen, it means just simply this: we will have no fish in our streams eventually unless we protect our streams from depletion by the irrigating ditches.

I am in rather a peculiar position here this afternoon and I will explain to you why. At this morning's session, if I understood rightly, Mr. Bower, from Michigan, stated in behalf of his own state that, with the exception of Colorado, Michigan could boast of the biggest fish liars. Now, I cannot understand why Mr. Bower should except Colorado and place us in the position of liars as fishermen. Judge Beaman took the floor a few minutes afterwards and said that the true sportsman and true fisherman of Colorado always told the truth. Now, gentlemen, you see what a position I am in. I wish you would give me the credit of telling the truth part of the time when I tell you the condition of the irrigating ditches and the condition of our streams. I will only give you statements that I can verify.

Last season the report came out in our paper from North Park under the heading of farmers fertilizing their ranches with our mountain trout. That looked like a pretty hard proposition. I can verify by eye witnesses that these trout were drained out by irrigating ditches onto the hay fields. The larger ones were taken for use and the smaller left there to rot in the sun. These fish had been placed in the streams by our fish commission. This is not only a condition in Colorado, but it prevails in Wyoming and other states where irrigation is going on.

Mr. Daniel B. Fearing, Rhode Island: I think the gentleman is wandering from the subject; he is talking on stream pollution.

President: I think Mr. Thomson is talking on Dr. Ward's paper, on the saving of the fish.

Mr. Thomson: I do not desire to speak only as I am speaking upon the paper, and I understood Professor Ward's paper was on the protection of our streams; I desire to go a little farther along this line. While I will mention no names, I think this statement can be verified, that in many instances the water is turned out of the ditches at night, where arrangements have been made beforehand, and then turned on before daylight, and the fish are taken for table use. There is no protection against this wrong to be secured at present either from the state or national Government.

PROFESSOR WARD: I cut out part of my paper. Perhaps it was not entirely clear. Undoubtedly my method of expression was not always such as to bring it positively before your minds. For two remarks made by those who discussed the paper did not seem to me to meet the conditions set forth in the paper. I believe in saving the small fish and the large fish, and I am confident, if we are going to save any part of our native fauna, we must save the birds or some of them; and if we save them we have got to let them eat. But if you preserve a stream in its natural condition, not straight banked and clean bottomed like a reservoir, but with the inequalities of bottom and the protection of cover at the shore that you find in a natural lake or in a natural stream, if you have such places as we have all seen in Colorado, where the logs have drifted down and the sticks have jammed together until no bird could get through there, and if you have places where the rushes are so thick and the moss, if I can use that term, so abundant that the big fish cannot get in there, then your little fish will get out of the way of both the big fish and the birds, and the birds will have some fun hunting and the big fish will have some fun hunting, and the little fish will have some exercise getting out of the way. What we need is to preserve a little territory in an absolutely natural condition, not cleaned up and modernized, but just as it would be in nature and suitable for the protection of the fish of every size.

C. K. CRANSTON, Oregon: My chief object in coming here was to learn. I understood the nature of the paper was the description of the conditions which prevail all too largely and to the change which has unfortunately come about in the condition of our streams from the natural condition to the present. What I would like to hear is suggestions of a practical nature whereby we may hope to improve those conditions, and to come down to brass tacks, so to speak, as to what we can do or suggest, to bring about a change of attitude on the part of the average community towards the pollution of our streams by the introduction into them of factory waste; and more particularly and specifically the correction of the trouble, that is almost universal, of the running of town and municipal sewage into water courses. There is the meat of the whole proposition, to get rid of that; and if there can be any suggestions made that will help me in the campaign that I am trying to institute in my state to correct that condition, I want to hear them.

PRESIDENT: I think Judge Beaman's suggestion last week was a grand one. He said we had the law already; what we need is its enforcement.

MR. CRANSTON: We have law enough, but it is necessary to get public sentiment to support the enforcement of the law.

PRESIDENT: I understand from Judge Beaman that any citizen can take this matter up by going to the attorney-general of the state and having a suit instituted. I did not know that until yesterday.

Mr. Cranston: I am advised by one of the members of the State Board of Health in Oregon that it is not the lack of law; the difficulty is that in order to bring action to enforce these regulations you have got to bring action against the people themselves. You know what that means.

Mr. Nathan R. Buller, Pennsylvania: I represent a state that has more pollution to the square inch of water than any state in the Union; and our laws covering that question are very good. We have a Department of Health, and not a Board of Health, but the Department of Health is ruled over by a Commissioner; his title is Health Commissioner of the Commonwealth of Pennsylvania. He has jurisdiction over all sewage from towns and cities in the Commonwealth; and while the question is one of great magnitude, he is working along these lines, that each town and each city will be compelled to put in plants to take care of their sewage, instead of running it in the public streets, as is done in a great measure at the present time.

I consult with him very frequently. It is not a problem that can be solved in a few weeks or a few months; it is a long-drawn-out question, and in these few years his department has been created he has done great work.

Now, a great many of these towns and cities at the present time are burdened with heavy debts, and it is a very hard matter to get them to issue bonds to build these plants; but it will all come; each town will be compelled to do it. This Health Commissioner, I might say, has unlimited means at his command to bring these matters about.

The Department of Fisheries has jurisdiction over the pollution of streams from manufactories, of which we have about 47,000 in the State of Pennsylvania that are running refuse into our streams at the present time. Such small problems as arise from the pollution of streams from sawmill refuse and wood alcohol and acid mills, are very easily solved; a great many of the acid plants today that are located on our streams are putting in plants that take absolute care of their pollution, so that in a very short time there will be no pollution in our streams from that source.

With the tanneries, of which there are quite a number, I have taken this course. I find, on investigation, that there is not much to be gained by sporadic attempts upon them. If you take a case here and there, there is not much accomplished. But in order to accomplish some results and eliminate this pollution, united action is necessary. I am shortly to have a conference with the representatives from every tannery in the State of Pennsylvania, and they as a body will work out some definite plan that each one is to pursue. With our paper mills we have the hardest proposition that presents itself, on account of the great amount of water that they use in the manufacture of paper; but it is a fact that I have visited paper mills on the Clarion River, which is a river so polluted that even a typhoid germ will refuse to live in it; and these paper mills are spending thousands of dollars each month to clarify the water in order to make a good paper, where somebody else has polluted the water above them; and then they run their refuse into the stream for the next man below to clean.

Now, I think if these manufacturers all get together there could be some definite plan worked out which would be successful; for the money that they are using today for clarifying this water would be spent in the effort to keep this pollution out; and then some results will be obtained.

Pennsylvania is working along those lines; and while it is a long-drawn-out question, I believe the time is coming when our streams will be purer by far than at present; but it will not be done in the course of six months or a year.

With respect to the matter of running off sand and waste from quarries that is a subject entirely taken up by a commission, called the Water Supply Commission; and a great many specific complaints that come to the Department of Fisheries on that line are turned over to them and given attention by that commission.

These are the efforts that are being put forth in my state looking towards securing the purification of the streams.

Mr. Ernest Schaeffle, San Francisco: Has any one found a way of handling paper mill refuse? We have had trouble with a mill at Floriston near the Nevada line. The only way we can think of is to shut down the paper mill, representing an investment of a million dollars, with a pay-roll supporting the entire district. Has any one any remedy to suggest for a problem of that kind?

Mr. Cranston: In Oregon City there is a paper mill having vats discharging into the Williamette River. It is a great nuisance. But we have secured the installation of a large settling tank for this pulp waste, and we have thus got around a good deal of the trouble. It has not entirely cured it, but has improved the condition perceptibly.

Mr. Schaeffle: That is in a place where they have room for settling vats. This mill is in a deep canon and there is no room to settle anything.

Mr. Buller: Are your paper mills sulphite or soda?

Mr. Schaeffle: Sulphite.

Mr. Buller: In several paper mills that I have gone over they are using large sedimentation beds to precipitate the lime and soda; and a great deal of their refuse is burnt up by being run through a hot retort.

Mr. Schaeffle: That is evidently a pulp mill.

Mr. Buller: I have found that 90% of all these manufacturers are perfectly willing to take care of this refuse if they are shown a way how. But to gain results we must first get some definite plan to work upon.

Mr. Schaeffle: These people will spend any amount of money, if I can tell them what to do.

Mr. Buller: We find the same thing. But they do not feel like abandoning their plants or spending thousands of dollars without gaining some definite benefit from it.

Mr. Schaeffle: Naturally.

Mr. Buller: A great many contrivances are used which are successful up to a certain point, but when they reach that point it is as bad as ever.

Mr. Schaeffle: I would like to say also that in San Francisco, where we have only one gas light plant, making 15,000,000 cubic feet a day from crude oil, that we have at last effected a means of restraining the lamp black, oil, tar and other products that went into the bay for 40 years. The gas company has spent $75,000 in constructing a filter plant which is now in operation, that not only saves this waste, but makes a valuable by-product from it. They are making briquettes from the lamp black in which there is enough tar to act as a binder. The same company is working on a new process of manufacturing in which there will be no waste product; the entire body of petroleum will be made into gas, although there may be a very slight amount of coal tar left. That was the worst problem we had at San Francisco Bay for 40 years. From the work that our chemists have done during the last year, it appears that in addition to the thousands of tons of lamp black and coal tar that have been poured into the bay, about one million pounds of cyanide of potassium has gone in along with the other material. But we have not found a way of restraining this cyanide, which is still going in with the wash water.

Mr. Buller: For the benefit of any member here, in states where there are acid of wood alcohol plants, I might state that at a plant that I examined a short time ago I found the system in use that absolutely prevents any pollution from getting into the stream. A couple of years ago they ran all the refuse into the stream, and destroyed the fish in the stream entirely. Today, by eliminating that refuse, the stream is being restored as a good trout stream again. The makers of the apparatus are Rieser & Sons, Tanners' Falls, Pa. Their system of taking care of this refuse is that after all the grease is taken out of their vats the refuse that ran in the stream before, which was a black substance about the consistency of crude petroleum, and very hard to handle, is run into large boiling vats and boiled down to a consistency where they can shovel it, and they now use it in their furnaces; and while they are not making money, it is paying them to use it as fuel; and there is absolutely nothing going into the stream but the steam that condenses in these vats; and I have requested every acid manufacturer in the State of Pennsylvania to do likewise, to boil their waste and use it in that way.

Mr. Schaeffle: How do you handle the waste wash water from petroleum refineries in Pennsylvania; I refer to the wash water containing sulphuric acid?

Mr. Buller: There is a question that I have not had time to go over carefully. I have not been in the oil regions up to the present time to investigate their waste; that is quite an extensive territory. While most of the sulphur water is running into waters where mines are situated along the streams, I have not been into that territory as yet. But the question is becoming one of such seriousness in the State of Pennsylvania in certain portions that the manufacturers themselves along the western waters are realizing the fact that this pollution must be taken care of in some way, on account of their boats, engines and every other thing that they use in the water. The Engineers' Society now are trying to devise ways and means to get rid of the water from the mines.

Mr. Schaeffle: I would like to warn any of you gentlemen who may come from the states in which oil refining is carried on, that something which a great many of us did not suspect, in looking for oil itself, is a very serious problem. I have found one refinery in California that empties as much as five tons of dilute sulphuric acid into the waters of our state every day—from five tons down to three tons, greatly diluted with salt water; and with this some 16,000 to 36,000 pounds of sodium sulphate are emptied into the streams. We have not found any way of preventing that waste. The acid as it comes from these stills, I presume, or the washing chambers, is in such very dilute form that there is apparently no way of separating it. It is out of the question to dry up the water or volatilize it. We are letting that go into the water and out into the bay until we can find a way of controlling it.

PROTECTION OF THE UNDERSIZED FISH

By G. H. Thomson

My paper will be mostly a summing up of the work performed during the last four years along the lines of education and protection.

The action which the American Fisheries Society took at its meeting held in Washington, September 21-24, 1908, when it recommended that the various state commissions educate the people by every means in their power to follow the directions given on my post card, which reads as follows:

A PLEA FOR THE FISH

When removing an undersized trout from your hook, always moisten your hands before grasping the fish; otherwise the dry hand will remove the slime from the back of the trout, when it is only a question of time until fungus sets in and the fish will die.

Always kill your fish that are large enough to keep, as soon as taken from the hook. This can be done by giving it a stroke with a stick on the head, back of the eyes. It will avoid all suffering, and make your fish far better for table use.

The American Fisheries Society, at Washington, D. C., September 21-24, 1908, recommended that the various state commissions educate the people by every means in their power to follow the directions given about wetting the hands.

Indorsed by twenty-eight fish and game commissioners throughout the United States.

G. H. THOMSON, FISH CULTURIST,
Superintendent of the Estes Park Fish Hatchery.

During the winter of 1908-1909 I took the matter up with every game and fish commissioner in the United States, asking for their endorsement of the directions. I secured the approval of twenty-eight. Many of them asked for the privilege of reprinting them for their use, which was granted.

I have used the press as a means of education. Many editors, just before the opening of the fishing season, have used the card as a standing advertisement for the protection of the fish which have to be returned to the stream. I have taken the matter up with our railroad officials, asking that, as they issue their printed matter for the tourist season, they insert my card. All have very kindly granted my request, and in this way fishermen are reached who would not be otherwise.

The subject has been taken up with fishing clubs. Some of them are printing the directions on the back of their membership cards.

I am distributing the card to visitors at the hatchery, to whom I show the fish which brought forth the publication of the card and which I saved from death from fungus by my treatment. Last season I had the card printed in the form of post cards, which I have given out at the hatchery as free printed matter. By this means I have secured for it a still wider circulation.

The subject has been taken up in the public schools as an object of instruction, and it should be taught in the schools. Why should not the coming fishermen be educated along the lines of fish protection? Our game laws in Colorado provide that all fish taken under seven inches in length shall be returned to the streams, but they stop right there and give no instruction as to how to handle the individual fish so that it may have an opportunity to live after being returned to the water.

In order that I might know something about how many people I have instructed as to the handling of the undersized fish, and also to whom I have exhibited my pet fish, I opened a register on the 25th of May, the beginning of the open season for fishing, and up to the 2d of September my register contained the names of 4,550 people. I have given out over 3,000 cards containing my plea for the undersized fish, also about 2,000 post cards with the same instructions.

My register contains the names of persons from China, France, Honduras, British Columbia, San Salvador, and from nearly every state in the Union. While the recipients may lose their cards they will never forget the instructions on protection given at the hatchery.

When we take into consideration the time and care that it takes through artificial propagation to bring one of our trout to the fishing limit of seven inches, and that one grasp of the dry hand, in taking an undersized fish from the hook for returning it to the water, removing nature's protection so that the fish will die after being returned, it seems to me that the American Fisheries Society should push the matter of education for the protection of the undersized fish as far as possible.

DISCUSSION

I would like to take a few moments' time in demonstration.

(Mr. Thomson here produced from a wooden box a sealed tube of glass about one-half inch in diameter and about four feet in length, containing specimens showing the various stages of growth of the fish.)

I can give you an exhibit here in this tube, of the stages from the time the eggs are taken from the fish until the fish are ready for the stream.

In our hatchery in Estes Park, the water stands at 46°; and it changed but two degrees last winter.

We take the eggs after they are fertilized and place them on the hatching trays, and they will require 40 days to reach the stage shown in this glass tube, when they are hatched out.

From the time the eggs are placed on the trays to the eyed stage, which is the stage when the Government do their shipping, it will take 25 days in a temperature of water standing at 46°. At this stage they can be packed in moss and kept at a temperature not colder than 38°. When the Government ships eggs to Japan and Australia, they ship them in the eyed stage.

You will see from the tube that after 35 days much greater progress is shown, and you can see the fish curled up.

In 40 days you will see the fish as they have passed from the egg state to the absorption state. There is a spot on the shell of the egg where each fish has passed through, as you will see in the tube.

Ten days after the hatching out you will see them at this stage. Then in 20 and 30 days they rise to hunt food. You will notice the development in 20 days and the further development at 30 days.

You will see here then the whole process of development, from the time the eggs are placed on the tray, until they rise to hunt for food, when we begin feeding them.

The best authorities which we have on the culture of trout say that only 3% of the trout reach that stage.

With ordinary care in passing through the hatchery, we will place out in the stream 75% through artificial propagation.

Now from this stage of feeding, on an average, it will take our young fish 15 months to pass the 8 inch limit.

When it takes that much time and care to raise a fish, it seems a shame to destroy that fish in returning it to the stream by handling it with the dry hand.

You will notice here something of the deformities found in fish during development, showing double fish and double-headed fish. As they reach a certain stage and as they absorb the yolk, they die; so you never find a double fish in the stream.

You will notice from this specimen which I show you, the cannibalistic nature of the trout. You will see the tail of one little trout sticking out of the mouth of another. There is no show for the weaker fish in the hatchery.

That will give an idea of the time it takes to bring one of our fish from the egg stage to the fishing stage.

I brought these exhibits, simply to demonstrate the time and the trouble which it takes to raise trout.

I have had fishermen say it is too much trouble to be careful in handling these undersized fish. But they are not sportsmen, for they are unwilling to take the trouble to protect the undersized fish; and if a man has not sufficient interest in the undersized fish to protect it after he has caught it, then I say he has no business to fish along our streams. (Applause.)

Professor Dyche: I think, in order to make an experiment of that kind of value, and in order to give value to ideas such as those put forth by Mr. Thomson, the experiments ought to be performed on rather a large scale. I myself have subjected a hundred or more fish to certain kinds of treatment. While experimenting we handled fish with wet hands and with dry hands, and also scratched them with small sticks and stems of grass and leaves, then they were placed in ponds and we watched for results. I am not quite ready to report on just all the things that have happened to those fish; further experiments are necessary. The trout are not perhaps any more liable to be affected by this fungus than many other kinds of fish. Catfish, bass and crappie, in fact nearly all kinds of fresh water fish, are more or less liable to be affected with this fungus disease. We have certain rules that we observe when we handle fish at the hatchery. My idea about the trout business would be to experiment on a large scale; a hundred or more fish should be used and the experiment performed at different times and under different conditions.

Fish culturists know that the white fungus is a disease that injures fish. Only exact experiments properly conducted will add to our present knowledge. Handling a fish with the dry hand may start a fungus growth on it. The wound inflicted by the hook in catching the fish may also start a growth of fungus even though the fish be removed from the hook with a wet hand.

I really think that before this Society could very well pass upon a thing of this kind and make recommendation to men all over the country, that it might be well to have experiments performed on a more extensive scale than with one, two or three specimens of fish under restricted conditions. I should think 100 would be a fair number to work with; that number would give an idea on a percentage basis easy to understand. If fish are taken that have suffered injuries in various ways, by the hook, the seine, or the hand, for instance, and placed in water under natural conditions and studied for several months, then one might get a fair idea of just what would happen to the fish.

Mr. Thomson is undoubtedly right in his statement that if you take a fish in your dry hand and rub the slime off, that it will injure the fish; however, we should like to know the percentage under different conditions, and that would require an examination of a large number of fish.

Another thing that should be borne in mind is that, that taking a fish off the hook in your hand and putting it back in the water is only one of the things that happens when a fish is caught on a hook. The ordinary fisherman pulls the trout (or other fish) out of the water, and before it is landed it turns three or four somersaults, lands in the bush or on the ground or rocks and gets generally bruised up before the fisherman ever touches his hand to it. Many other injuries besides those inflicted by the dry hand may cause fungus growth on fish.

Mr. Thomson: I do not think Mr. Dyche quite understands my position. I did not ask for recommendations from this organization on that proposition. My paper was simply a report upon the position this organization took in 1908 in Washington, when they recommended that the various state commissions educate the public as far as possible in the wetting of hands. Our trout is quite different from the fish in warm water streams. You remove the slime from the back of our trout and you remove nature's protection.

Mr. Daniel B. Fearing, Rhode Island: I would like to relate an experience which I personally had. I happened to be chairman of the oldest trout-fishing club on the island of Long Island in New York State; and we have the finest wild trout fishing that there is in New York State. We have only 15 members in the club. We have about seven miles of the Connecticut River, so-called, running through Long Island; and we never keep a fish weighing less than half a pound; we throw everything else back. We always fish from boats, and the boatmen are always instructed, and they always do wet their hands before handling fish.

Some eight years ago I started an investigation on my own account, and I got a conductor's punch that was made very small and very sharp; and every fish that I threw back, the man wet his hands before the fish was taken off the hook, and a small hole was punched either in his dorsal fin or tail, and I threw back that fishing season between 480 and 500 half-pound fish, and not a single one of those fish was ever seen again—was ever taken again. Now, those fish we handled as carefully as possible with the hand wet; and they were only thrown back if they were not bleeding in the mouth and were not badly hooked, and the hands were always wet before they were thrown back; they were treated with the kindest consideration possible, and yet not a single one of those 500 fish was ever seen again.

Mr. Ernest Schaeffle, San Francisco: Is it not possible that the markings had regenerated?

Mr. Fearing: Did you ever know of a case of a fish generating a tail which had a hole punched in it?

Mr. Schaeffle: They do regenerate in California.

Mr. Fearing: It is not supposed to be possible.

Mr. Schaeffle: That has been our great trouble, and we have marked salmon and trout.

Mr. Fearing: They mark salmon in England by a silver wire. I will ask Professor Ward: Is it not supposed to be impossible for a fish to regrow an attachment of that sort?

Professor Ward: I cannot say with respect to those fish.

Mr. Fearing: Did you ever hear of trout or salmon that would grow a tail after one had been lost?

Professor Ward: I do not know of experiments on salmon and trout. As far as I know of such mutilations they remain unmodified.

Mr. Fearing: Do you known personally of a trout or salmon being marked in that way?

Mr. Schaeffle: Yes, we have done that. These marked fish have been held in troughs and special ponds, and we have watched the fins regenerate.

Mr. Fearing: I never heard that in salmon and trout.

Professor Ward: Your statement is that none of those fish have ever been returned. Is it not probable that they may have been taken and not reported?

Mr. Fearing: No. A careful record of them has been kept. This is in a private club, and everything was marked, and watched, as I said.

Mr. Thomson: How were those fish marked?

Mr. Fearing: With a perfectly clean-cut round hole right through the dorsal fin or the tail. I would like to inquire from Mr. Schaeffle the source of his information.

Mr. Schaeffle: I have taken my report from an employe who is in charge of fish cultural work in California.

Mr. Fearing: Then your information is not based on personal examination?

Mr. Schaeffle: There is no doubt of the fact.

MR. CRANSTON: Is it your opinion that a mark in the nature of a hole cut out of the gill cover, would be an enduring mark sufficient to identify fish at any time thereafter.

MR. FEARING: I did not refer to the gill cover; but to a round hole cut in the fin or tail. Could such a hole unite. Perhaps the tail will grow, but will not the hole remain?

MR. SCHAEFFLE: We have experimented with marks on the rainbow, the steelhead and the salmon.

MR. FEARING: Is it true that you found the only way of marking salmon was with silver or copper wire?

MR. SCHAEFFLE: That is what we are doing.

MR. THOMSON: In my hatchery the fish lost the entire fin; if that fin had been marked it would have been lost. There was not a thing to show for it. The caudal, dorsal and pectoral fins come right off close to the fish's body.

MR. FEARING: Then you idea is that in the case of a fish marked in that way, nature would make it lose the entire fin or tail?

MR. THOMSON: Yes.

MR. FEARING: That would explain the thing.

MR. THOMSON: I had several fish there at the time, and they were all cured of fungus growth.

MR. FEARING: We have cured any number of fish of fungus by putting them in a salt water bath, and we do that as a rule.

MR. THOMSON: That is proper. I have not marked the fish that way; but it would have disappeared anyway.

MR. FEARING: That would explain the fact that we never saw them again. It has never been brought up to my knowledge.

MR. THOMSON: I know absolutely; I have watched the thing right through. There was not a thing to the fish; it was a bobtailed fish.

MR. FEARING: Then your idea is that they grow new fins as a lobster grows a claw.

MR. THOMSON: Why shouldn't they—just as a bird will grow a new claw.

MR. FEARING: It is very interesting. I never heard this view taken before. No one seems to know of it.

MR. THOMSON: I am speaking of my own investigation.

PROFESSOR DYCHE: You have suggested some very remarkable things in connection with the moulting of the fins of the fish. I have been looking through fish literature and making experiments for a lifetime, and this is entirely new to me. It is so new and interesting that I would be glad to come out and spend a month or two with you and have you help me to perform some experiments.

MR. THOMSON: I give you a standing invitation to do so.

PROFESSOR DYCHE: I am building a laboratory for carrying on investigation; but I cannot handle trout in my laboratory.

MR. THOMSON: Trout in cold water streams are quite different from fish of warm water streams.

Professor Dyche: I do not know anything about trout.

Mr. Thomson: Take trout in water warmer than 74°, and these trout will live longer in the grass than in the water.

Mr. Dyche: I should like to see some experiments carried on in this line.

Mr. Thomson: I should be glad to cooperate with you. I have had considerable opposition on that line, but not with fishermen. There is a difference between fishmen and a fisherman. Some of the oldest fishmen in this state came out bluntly and said the whole proposition was bosh. One of these fishmen said that he had been in the fish business 25 years in Colorado and had handled hundreds of thousands of pounds of fish and had never found that condition to exist; and that if it did exist, our fish would die by the thousands.. But he was speaking from the fishman's standpoint, when in the spawning field they were taken out of a tub of water, and the hand was wet, and not from the fisherman's along the stream when the hand is dry.

Mr. S. E. Land, Denver, Colo.: As I understand it, in the case of a fish taken without moistening the hand, the mucous is removed, thus causing fungus, and the fish shed their fins because of the fungus.

Mr. Thomson: That fish shed its coloring from the treatment I gave it; it lost its fins and every particle of coloring; it was strictly a white fish.

Mr. Land: To what do you attribute it, to the removal of the mucus on the fish from the handling with dry hands?

Mr. Thomson: I can answer that in this way: When a bird loses its feathers, it has nothing to protect it. Now the protection of that trout was the slime on its back—nature's protection—and the use of your dry hand, contrary to the order of nature, will remove that protection.

Mr. Land: When Dr. Bean was Director of the New York Aquarium he gave me a demonstration of how he cured fish from which the mucus was gone through injury or fungus. He used salt water from the ocean.

Mr. Thomson: I have used peroxide of hydrogen—just raised the fish enough out of the water to pour peroxide on it; and I have thus destroyed the fungus and saved the fish.

Mr. Land: I am like Professor Dyche; I want to have a scientific demonstration of these things. But I admire Mr. Thomson for the step he has taken in regard to the protection of the undersized fish.

I am operating now on the Cottonwood Lakes in the Grand Mesa of the Colorado. I have had bills printed on cloth, using the very statements that Mr. Thomson makes on his cards. Its effect in the education of the people has been very marked, and they are all handling their fish with much more care. It is a grand and humane thing to have undersized fish returned to the water without injury.

It is important also to get people to act in cooperation with the boards of health, by being careful to avoid throwing entrails of fish, or washing fish in the streams. On the Cottonwood Lakes we are earnest in our endeavor to educate people along the line of keeping the waters pure.

WATER POLLUTION

GEORGE W. FIELD

When Colonel Acklen referred to the pollution of the streams of the United States, I felt that he had struck the keynote of the meeting. This is one of the most important problems before us, both as citizens and as commissioners. The condition in Massachusetts has been acute for many years. Two years ago a law was passed by which it was absolutely forbidden to place in the streams of the Commonwealth sewage, manufacturing waste, or any material whatever which in any way, directly or indirectly, could be prejudicial to fish life, and by that I mean not alone injuring the fish but injuring the food—the microscopic plant or the microscopic animals in the water upon which the fish depend in any degree. Now, as a result of the conditions there, two very important decisions have been made by the courts, which I feel are of very great value to all of us, not alone to the citizens of Massachusetts, but to the citizens of the United States. Of the two hundred and more cases upon which we have taken action, only two have been appealed from the decision of the lower court. One of these went to the Supreme Court on the grounds that the defendants had been putting this polluting material into the streams for upwards of 200 years; therefore they claimed that they had gained by prescription the right to continue the pollution. The Supreme Court decided specifically that no individual or corporation could acquire by prescription such a right against the state; that the fact that they had not earlier been prevented from putting this material into the stream was no reason why they could not be so prevented at any time.

The second case is equally interesting and important from another point of view. When the issue arose as to what constituted the "fisheries value" of the stream, we were directed by the Chief Justice to consider not alone the present value of the fish which could be taken from that stream, but the potential value of that stream, what it could be made to produce in fish for food, and in addition we were to consider the recreational value of the stream as a beauty spot.

We do not contemplate a rabid agitation or any ill-advised attempt to force manufacturers to do anything prejudicial to their real interests, but we believe that in the course of five or ten years some very progressive steps will have been taken.

Very strong pressure was placed upon the Governor when the legislative act came before him for approval. He had fully made up his mind to veto the measure; when he called me in consultation, I directed his attention, among other things, to the fact that Boston, by turning its sewage into the harbor, was destroying an annual value of over $400,000 worth of shellfish each year. Now, that is but a fraction when compared to the waste and destruction wrought by the mill waste and other material that goes into the Blackstone, Merrimac and Connecticut Rivers, and the myriad of smaller streams, not to mention numerous state ponds.

In this connection not alone must we consider the actual value of the fish life rendered impossible, but in addition the waste of an inconceivably vast amount of valuable material which should be used for fertilizing the land.

We have made experiments and observations which indicate that this material, if placed upon the land, will be turned into plant food in the quickest possible manner; if placed in the fresh water streams, it changes to plant food somewhat more slowly; if placed in brackish water, considerably more slowly, and if placed in salt water, very, very, slowly. There, instead of being turned into plant food, it is rapidly precipitated and drops to the bottom as a slimy sludge, which will be of practically no value as plant food for years and years to come on account of conditions unfavorable to oxidation and nitrification.

Looked at in a very large way, what are we doing all over the United States? We are collecting water which formerly spread over and irrigated the ground and conducting it in closed pipes down to the cities. I am speaking more particularly of eastern cities. Thus in Boston and New York inconceivable quantities of water are diverted from the natural use and brought prematurely, so to speak, to the ocean, without doing the work which was its original and natural function.

In addition to that we are diverting this material which should go back to the land as a fertilizer, and which as sewage variously mixed and modified is in Germany, at Berlin, and other places, used for irrigating and fertilizing the land. This land is rented to the farmers for $30 or $40 an acre, or practically the same price which farmers pay here for water privileges on irrigated land. That fertilizing and irrigating material is turned into the ocean prematurely can mean nothing eventually except a vast destructive economic waste.

I do not believe we are in position immediately to overturn all our systems and ideas of sewage disposal; but the time is coming when we must use this material on the land for irrigating and fertilizing purposes, and we must use and maintain the waters in a condition suitable for the development of the fisheries.

We had in Massachusetts the salmon fisheries, shad fisheries, alewife fisheries and smelt fisheries of a value of upwards of half a million dollars annually, which are absolutely destroyed by this indecent method of sewage disposal.

THE BLACK-SPOTTED MOUNTAIN TROUT

(Salmo stomias and related species)

BY S. E. LAND

Introductory comment by the reader.

Before I read my paper I would like to make a few remarks on the paper that our worthy President, Mr. Fullerton, brought up at the St. Louis meeting. The food problem regarding trout, and the question now before us of how we shall raise the standard of the domesticated trout, are important. The problem is, how can we make them produce a progeny equal to that of the wild trout? I have on exhibition here trout that have been introduced in the State of Colorado from California. They grow to great size in our waters, in our cold streams fed apparently by snow water, especially in the month of June, and there the development of the eggs is retarded, because they are transferred from California, where in their natural habitat they reproduce in February and March, and in our icy elevation of ten thousand feet they do not reproduce until the latter part of June and up to the 10th of July, keeping their reproduction of eggs back for five months. Nevertheless they grow to a great size. This first trout which I exhibit was caught in the southern part of the state by a man present here today, from Elbow Creek, that empties into Electric Lake twenty miles from Durango. I helped land that fish. From that lake we took two million eggs of the rainbow trout. This second trout was taken from the headwaters tributary to the Rio Grande from Charles Mason's Lake. It is a cutthroat trout with the fine spots (*Salmo spilurus*) and is known as the black-spotted mountain trout. We have also the black-spotted mountain trout with large spots that lives in the higher waters of the mountains and never moves from this environment.

The first fish weighs about ten and one-half pounds, and the second five pounds. The second one is from the lake, from those waters that run down into the Rio Grande.

This third one belongs to an introduced species, *Salvelinus fontinalis,* and is from a lake somewhere in the Rocky Mountains here; but they grow also as heavy as five pounds in lakes, and they do not grow more than half that size in the rivers, and much smaller in the smaller streams. They also retain their size and beautiful colors as they are brought from the New England states or Pennsylvania. The habitat of the last trout (*Salvelinus fontinalis*) ranges from Georgia all through the Allegheny Mountains, Pennsylvania and up to the British possessions. The first one is from California, and the second one I will refer to in my paper.

I have also a specimen which, after I get through my paper, I will refer to.

In regard to the food of the trout of the Rocky Mountains I have samples preserved so that you can see what the trout live on, and I will say that the same aquatic insects destroy the eggs and the young of the trout.

The species is distributed throughout the inter-mountain states. As stated by Dr. Jordan: "It was born in Alaska and has worked its way southward and eastward into the streams of the great Rocky Mountain region. It is one of the handsomest and finest, yet it has rarely been transplanted to waters of other than those to which it is native. This trout is usually known as the 'cut-throat' trout, from the half hidden gash of deep scarlet which is always found just below the base of the lower jaw. Other marks are the rather long head, which forms nearly the fourth of the length of the body from the snout to the base of the caudal fin. Almost always there is a narrow line of very slender teeth along the middle lines of the base of the tongue, besides the larger teeth, which surround the edge of the tongue in all trout. The body is usually well spotted, and the spots are a good size on small fish and finer on the larger ones, there being none on the belly. This species is the most widely distributed of the trout."

The State of Colorado has devoted a great deal of time and money to the rearing of this species, as well as to the introduction of the brook trout of the east, and the California rainbow trout.

In 1882 the brook trout were hatched and distributed in a small way here; and in 1886 the eggs of the McCloud River rainbow trout were secured and hatched in what is known as our Denver state hatchery. These fish were introduced in the Platte and Gunnison rivers of the state. A few years later the eggs of the Green-back or Arkansas trout (*Salmo stomias*) were first taken from fish found in Twin Lakes near Leadville, of this state. Since that time, the collection of eggs of the native trout by what is known as "field work" has extended to most every part of the state, taking in from eight to ten large lakes and reservoirs. With the improved method of taking and handling spawn of the native trout, we now collect from ten to fifteen million eggs annually.

This species should be handled with great care, to save the fish from injury, as well as to prevent the loss of eggs. According to the temperature of the water the milt dies from three to five minutes after it is taken from the fish. Fish eggs should not be taken in water in a pan of expanded eggs covered with water, or in floating dead milt. This is done by the novice too often; by our method of wholesale collection of eggs from wild fish. Nevertheless, we pay for it dearly by having to pick out a large percentage of these unfertilized eggs at the hatcheries. Another thing I would call attention to the fish culturist is, that we find on examination of these trout that you cannot take the last few eggs from them, as a few eggs are in the same condition in them at the upper end of the ovaries as all eggs are in the roe in an unripe fish. That is, they are connected by little blood vessels, and when forced from the fish by a novice with continued stripping are released and appear like the other eggs, but they are immature, and cannot be fertilized. This adds more useless or dead eggs to the hatchery work. More important yet is that the parent fish die and thus diminishes each year our annual output of eggs.

We are now more fully utilizing the lakes and reservoirs as a source of supply for eggs that the fry hatched from them may be used for stocking barren and depleted waters. We are not relying on our streams as heretofore in the collection of eggs from wild trout.

Packing and Shipping

Packing and shipping green eggs of the native trout from the field stations to the hatcheries requires great care from start to end of destination. Packing the eggs consists in placing them in cases, which are shaped so that they can be put on pack-horses, each case holding one hundred and sixty thousand eggs. Each horse can carry two cases, a total of three hundred and twenty thousand eggs. The native trout in these mountain lakes (elevation 10,000 feet) spawns from the 15th of June to the 15th of July. Thus the period for taking eggs is quite limited.

From the pack-horse, the cases of eggs are conveyed by wagon to the railroad, thence to the several hatcheries. From the time the eggs are placed in the cases, until they are in the hatcheries, they are kept at a temperature of 34° by ice and ice water poured over them during transit. Should the temperature in the cases rise, incubation starts and the eggs die in transit. The eggs we take from the rainbow and brook trout are handled in the same way when shipped green. We have no sub-stations large enough to eye eggs before transportation to the hatcheries.

The state has seven operative trout hatcheries, ample to stock all the waters of this commonwealth, and to improve legitimate angling for all time to come. The work of operating the hatcheries by the collection of eggs from wild fish and the distribution of the fish has become a very important branch of the game and fish department. Hatcheries are expensive to operate, and competent fish culturists are scarce for stations already in commission. The present commissioner, believing in economy and efficiency, is encouraging the sportsmen's associations to build club hatcheries, at their own expense, along the most important streams of the state. During the past year, quite a number of such club hatcheries have been built by these fish and game associations. The method proposed is, that the state furnish the eggs from their field stations, and the members of the associations pay the expenses of a man to supervise the hatcheries and the distribution of the fish in the public waters. In this way people find that they can have all the fish they want in their districts by co-operative work. By this method the individual becomes personally interested in protection, which is an incident to propagation. Surely the lovers of sports afield and even the fish "hog" should be satisfied with this generous spirit, knowing that he, too, is assisting to make Colorado not only the playground of America, but one of the most famous sections for trout fishing that can be found in any of the states in the nation.

Distribution of the Trout

By handling the three different varieties of trout we keep our seven state hatcheries in operation throughout the year. This is why we are able to distribute annually from fifteen to twenty million fry.

With few exceptions, and that through accident or carelessness, we have no loss in our work—for example, we have taken young trout (fifty thousand eastern brook) in cans from water in the hatchery at forty-six degrees temperature, reduced the temperature slowly down to 36°, carried them by rail a thousand miles and on a change of railroad line, thence 35 miles by wagon road to a mountain lake (10,000 feet elevation)—the trip in all lasting four days and four nights. During this time, the water was not changed in the cans, but by adding ice and pouring out the surplus water, we kept conditions so that the loss did not exceed 2% from transportation. None died but from natural causes. The lake in which they were placed was an artificial reservoir above the falls near timber line. It never had a fish in it and these brook trout grew to measure twelve inches in length in two years. That is one instance that proves how fish can be handled in transportation, even in ice-water, without loss at the time or thereafter.

In our lakes, the trouts feed on the young of the salamander or water dog, the leech, the fresh-water snail and the fresh-water shrimp. When abundance of the latter are found in our mountain lakes, the trout feeding on them, the flesh of the fish is red, and during the spawning season the male fish puts on the brightest scarlet colors on the belly and below the lateral line. This only in waters where this crustacean exists. In all waters where the fish diet is on the young of the salamander, or the young of the inferior varieties of fishes, as well as the hellgrammite and caddis fly, the flesh of this fish is either a pale yellow or white.

I find that the streams that flow from the Continental Divide to the Atlantic Ocean and through the great Utah Basin to the Gulf of California, contain the cutthroat trout and its sub-species with but two exceptions: the North Platte and the Powder rivers and their tributaries in Wyoming, the latter streams never had any trout of any kind in them naturally. Since my investigations in the '80's, these, as well as most other streams, have been liberally stocked with trout of the two varieties introduced—rainbow and brook, by the Wyoming hatcheries and the national fish commissions. During the years

1891 and 1892, the State Commissioner of Colorado placed many of the native trout in the headwaters of the North Platte in North Park, Colo., as well as the headwaters of the Big Laramie, in Laramie County, Colo.

In the headwaters of most all these mountain streams the cutthroat at the higher elevations has the habit of locating and is non-migratory, but remain there in those small mountain spring brooks all winter, when covered with snow from 5 to 10 feet. It does its feeding in the five summer months and practically hibernates in the cold water in winter. The individuals seldom grow to exceed 12 inches in length, and they invariably have a few medium large spots on the body back of the dorsal fin and above the lateral line, while the individuals of the same species which inhabit the rivers and large creeks of this region invariably have many more and much finer spots—the latter fish being much more migratory, going up in the spring high water to spawn, and down in the fall and winter when the water begins to recede. They vary with their surroundings, and, like their brothers in the upper waters, they can change their color to match the color of the bottom over which they live. As to the texture of their flesh, it is the finest of all, in hardness, flavor and quality. They are exquisite fishes. Their size depends on their food. When large, or of fair size, they are extremely gamey, especially in the swift waters of our Rocky Mountain streams. Therefore, to the disciples of Isaac Walton, the lovers of sports afield, and to all others, they are the trouts par-excellence of the Rocky Mountains.

[Mr. Land evidently confuses several different species under the one name, Black-spotted Mountain Trout. A part of what he says applies to one, a part to another and still other parts to other species.—*Editor.*]

DISCUSSION

Mr. Daniel B. Fearing, Rhode Island: I should like to ask the gentleman a few questions: Do I understand the speaker to say that that is an extraordinary size for the cutthroat trout?

Mr. Land: That is the Riversize. We caught those before there were any fish planted of that size in the Gunnison River, in 1882.

Mr. Fearing: The reason I ask that question is that I have just returned from a trip through the Rocky Mountain Park in Canada; and in the Spray River there they have a native fish which they call a cutthroat. He looks as much like that fish as a mackerel looks like a trout. He is a bright silver, has the slightest trace of color in him, with black spots. Yet he is called the cutthroat trout in Canada; and is a native fish in all the Rocky Mountain preserves near Banff. An extraordinary size is considered to be two pounds. They catch thousands of them from 6 to 8, 10 and 12 ounces, and occasionally at the head waters they catch them up to two pounds; and then they think they are getting very large trout. The reason I ask is that he is so totally different from the fish you have exhibited.

Mr. Land: Do they have the markings on them?

Mr. Fearing: Yes, very slightly. It is a silver-backed fish and is by no means the same shape as the fish shown by you.

Mr. Land: Where do these waters empty?

Mr. Fearing: The Spray empties into the Bow River. They run down finally into the lakes. The Bow River finally ends in Lake Superior.

Mr. Land: I take it from Dr. Jordan that those fish have traversed only the Rocky Mountains. On one side they go into the Pacific; and the other side, as they get lower down———

Mr. Fearing: The streams that I speak of are on the Atlantic side of the Great Divide.

Mr. Land: Yes.

Mr. Fearing: They flow down, as I say, into Lake Superior. The Spray runs into the Bow and the Bow into Lake Superior.

Mr. Land: Yes, and I can refer to Judge Beaman to support my statement.

Mr. Fearing: Is it the same fish?

Mr. Land: That I don't know—I never investigated those waters, but I will say this, that the sub-species are so different in markings that it is hard to distinguish them by means of spots. We know the Platte by their markings; and we know those tributary to the Colorado and Snake Rivers in the same way.

Mr. Fearing: Professor Ward says they are a different fish.

Professor Ward: I think I quote Dr. Jordan correctly in saying that the term cutthroat trout applies to a group of trout and not to a single type or individual; and I recall distinctly that there is a great deal of intergradation and confusion between the different species. I had the pleasure last summer of fishing for three weeks in the Rio

Grande valley above Creede; and the cutthroat I caught there I could not myself reconcile with the book descriptions, which simply confirmed the statements that these different types are much confused and intergrade greatly at different points.

Mr. Fearing: That is what I remember from my own reading and seeing that fish and the fish in Canada, I could not see how they were the same fish.

G. H. Thomson, Colorado: On the coloration of the black-spotted cutthroat trout I would like to have a few words. I believe Dr. Jordan holds that there are 15 different varieties of that family. Now, I had a little experience in Estes Park just along this line. I will not call the gentlemen I refer to by name, because some of our Denver people might know him, but he has a place near Timber Line in Estes Park. He has a lake stocked with black-spotted trout. A year ago some parties came down to our hatchery, and, as I was exhibiting work in the hatchery, one of the gentlemen said: "Did you know that So-and-so has a different variety of the trout?" I said I did not. "Well," he said, "he has, and he is tickled to pieces over it; he said that he had a strictly different variety of the trout in that lake of his, although they were all put in there at the same time." This was in the month of July. I asked the party how he described them. "Well," he said, "there were some of them that were the ordinary color of the black-spotted trout, had their general colorings along the side, and the spots back of the dorsal fin, and the slash underneath the throat, of the cutthroat; and the others had that slash underneath the throat and underneath and clear to the top of the back, to the top of the dorsal fin,—they were as red as could be—a separate, distinct variety of the trout." Well, it amused me somewhat. I said: "Could he not tell you what the trouble was?" He said: "No." I said: "You go back and tell this party that his strictly new and beautiful trout is the male fish at spawning season, carrying its brilliancy to a high degree. The fish feed upon a red parasite or insect which gives the male more brilliancy than they otherwise would have. I never heard anything further of his new variety of trout.

I was glad Mr. Land in his paper pressed an invitation on you to visit our mountain streams. Now, gentlemen, I do not want you to forget for one moment, whether you have the opportunity at this time or at any other future time, that we have one of the prettiest places in Estes Park that you have ever visited. I am not going to try to describe it to you; I simply give you the invitation, and if you ever have an opportunity, come to Estes Park and see it for yourself.

Now, the question comes to all parties coming to our mountain districts for the summer, what is your fishing? It is not our mountain scenery that is the attraction altogether; but our fishing? Our Game and Fish Commissioner is stocking our streams with the three varieties of trout; and wherever you go in the Rocky Mountains you will find them in the streams. The higher up on the stream, the colder and swifter the water, the more firm the flesh of the fish is, and they are all game fish.

I would like to ask Mr. Land just one question, if I may have the pleasure of doing so. He referred in his paper to the fish hog. I would like to know if he has found any proposition whatever that will satisfy the fish hog in fishing?

Mr. Land: Well, the fish hog is so universally known commercially and among sportsmen, that it is not necessary for me to speak in his favor or against him. I think we are trying to eliminate the fish hog as well as the game hog—ostracize him from civilization.

Prof. L. L. Dyche, Kansas: Mr. Thomson made one remark which perhaps I did not quite understand. In referring to the sexes of the trout, he made special reference to the male as having a red stripe or red coloration on the back, where the female did not have any. Then I understood him to say this was due largely to a red parasite or insect that the fish fed upon. Is that right?

Mr. Thomson: Perhaps I did not make myself plain. Take our lakes in the high altitude, there is a red parasite or insect that our fish feed upon, giving the flesh a different color, more of a pink color, than the white, the natural color of the black-spotted trout; and it gives the male trout more of a brilliancy than he would otherwise have.

Professor Dyche: What parasite is this, do you know?

Mr. Thomson: I am not prepared to say.

Professor Dyche: Is it a parasite?

Mr. Thomson: It is insect life found in the water in the natural moss in these lakes; and you do not find it unless you go to a high altitude. Take the eastern brook trout in some of our lakes, at Timber Line, and many, as they catch them, declare that they are the salmon trout. This error is made simply because of the coloring of the flesh, due to the parasitic or insect food referred to.

Mr. Land: I will say, in answer to your question, Professor Dyche, that that is caused by the fresh water shrimp. The fresh water shrimp so impregnates the fish's flesh through the little globules of the crustacea, that it causes the fish to become very brilliant during the spawning season, especially the male, and sometimes the female, but principally the male; and wherever we find the fish of any kind in these mountain lakes feeding on the shrimp, the flesh becomes highly colored. The same holds true with regard to the salmon of the ocean. I believe it is the shrimp there that causes the change of color. I have taken fish from the lower elevations and put them in the lake and they become red, although they were pale and white before. Fresh water shrimps are found in abundance throughout the waters of the Rocky Mountain states.

Mr. William L. Finley, Portland Ore.: We have a great deal of difficulty in the identification of those trout in Oregon, and perhaps more than in some of the middle states, possibly it may be due to the fact that we have fish that come in from the ocean, sea-run fish and other fish, that seem to stay in the headwaters and spawn. These sea-run cutthroats, or salmon trout, as they are generally called by the sportsmen, come into the rivers from the sea along through the late summer, and begin spawning in November and December. One feature is that these fish coming in, as far as I have observed, have lost almost entirely the red marking on the throat. I should like to ask whether in the spawning season that is the case with the trout in Colorado, whether they retain that marking during the entire period or not?

Mr. Land: I will say they do.

Mr. Fearing: I would say to Professor Dyche that the coloration of the flesh had been abundantly proven in the case of Long Island trout. Take the case of the South Side Sportsman Club where they breed thousands of trout for their members, for many years previous to the last two years, those fish were fed on beef liver and hog's pluck's, and they were turned out weighing one-half pound and up, for the members to catch. But it is like fishing in a bathtub. The fish were so starved that they would bite anything, even a rag. But those fish bred up and fed in that manner were all white meated. Two years ago some of the members objected to the fact that the people they gave these fish to said they were not fit to eat, that they were soft and flabby;—it was the truth. Then they began feeding these fish on mummy chugs, shiners and all sorts of small fish caught in Great South Bay, and from that time on their meat gradually turned from white to pink. The brook trout that are wild in the southside waters are bright salmon colored, pink, and those fish feed on the fresh water shrimp and fresh water snails. Thirty-five miles below that location there is a club to which I belong, where the fish are wild and feed on shrimp, snails and larvæ, and the meat is red.

Mr. W. E. Musgrove, Colorado: I have noticed that there was a greater variety in the color of eggs taken from fish than there is in the color of the flesh; and my theory is that the difference in the color of the fish comes from the different color of the egg from which the fish is hatched.

Mr. C. K. Cranston, Oregon: I want to ask Mr. Fearing if the change in the diet of these bathtub fish he described improved the quality of the fish as to taste?

Mr. Fearing: Absolutely—it made the fish fit to eat.

Mr. Cranston: Were they as good as wild fish after this change in diet?

Mr. Fearing: Very nearly,—yes, sir.

Mr. Musgrove: I would like to relate a little experience I have had, and ask other members for the benefit of their experience. I have a number of lakes which are stocked with fry of the brook trout obtained from the Government hatchery at Leadville, and in transferring these fry from the hatchery to my lakes, until within the last few years I have usually had a loss of about 90% of the young fish.

I attributed this largely to the fact that in placing the young fry in the water of the larger lakes, where there was a superabundance of food, that they gorged themselves to death. This led me to construct at the head of each lake a small nursery, in which there was not any great abundance of food; and I turned the fish into these nurseries and retained them until they reached one to three inches in length, and then released them into the larger lakes. This system gave me better results, but I had one lake in particular on which shores were very precipitous, at an angle of 45°, and whilst I had transferred fish 3, 4 and 6 inches in length into that lake and they nearly all lived, whenever I transferred fish direct from the hatchery into this lake where these precipitous shores were, they invariably all died. I hardly ever saw one young fish after making this transfer. That was a mystery to me. For a number of years I could not find any solution of it; and finally it occurred to me that in transferring the fish from these shallow hatching boxes at the hatchery to the deeper water, the increased pressure on the bottom killed them. I recalled the circumstance of fish being brought up from the greater depths of the ocean to the surface for examination, and on reaching the surface they were all invariably dead. Well, now, I thought if that occurred in bringing them from the deep water to shallow water, why should it not occur in taking them from the shallow hatching troughs and transferring them to water which, within a few feet of where they were planted, was 25 or 30 feet deep. I thought this must be the cause of this great mortality. I studied the matter, and the more I studied the more evidence I could find, but only circumstantial evidence. I communicated with the U. S. Fish Commission at Washington, and they told me my theory was not correct, that the small fish were consumed by the larger fish in the water. But if there were any larger fish in the water at that time they knew more about it than I did. There were none, gentlemen. In transferring small trout fry from the hatching troughs to larger bodies of water there is usually a large percentage of loss. This loss is supposed, by those who do not closely study the conditions, to be due to the cannibalistic habits of larger trout. While cannibalism does prevail to some extent among all members of the trout family, I think they are accused of more in this line than the facts will justify and that the great mortality among newly planted small fry is caused more by unfavorable environment than by cannibalism. If any of you have had a similar experience I would like to hear it and to receive some corroborative evidence as to the correctness of my theory.

(Mr. Land here exhibited in small bottles preserved specimens of various insect life, which he described.)

Mr. Land: I just want to draw your attention to the insects that the trout live on, and to the fact that the same insect, the caddis fly, in its larval or gnit state, destroys the eggs and the baby trout. I show you here a specimen of a caddis fly. This fly throws a web around so that it can feed on 9 eggs. This was taken off the trays in the hatchery; and then it will live on those eggs, until it changes from its larval state into the caddis fly proper. It is the larvæ that is consuming the eggs.

The next bottle I show you contains the caddis fly in the larvæ. The caddis fly is here rolled in its shell covered with sand; it throws a web around itself, rolls in the sand and makes a sand-covered shell; it covers itself with leaves or bits of wood, if it cannot find sand to collect on outside, gets under a flat rock, and stays there until changed from the chrysalid stage into the fly stage. They are eventually eaten by the larger trout, both in the larval and fly stage.

We have here millions of them; and that and other food is what supports the life of the fish, from the cradle in the baby stage to the grave—which that 10-pound fish means.

In this bottle is contained what is commonly called the hellgramite, but which is the stone fly; here it is the chrysalis from which it leaves its shell; and after it leaves its shell on the rocks it is a fly, reproduces and dies. The eggs hatch directly into the water, go among the stones, and being hatched become flies of various sizes, from half an inch long to as large as your thumb. They are known as the stone fly throughout the United States.

In the larger streams they are found as long as your thumb, and are known as the willow fly by sportsmen. Here is the diving bettle, the wolf of the waters, of all aquatic insects, in regard to the destruction of fish life. This beetle you see is in his larval stage. It has hard wings in the beetle state. Some of these beetles are found as large as your thumb. I found one inside of a 14-inch trout that had irritated the stomach of the trout so that the fish died. When I cut him open the beetle was undigested. The trout will not eat it if it is possible to avoid it, but they live in the mud and come up to the surface, casting a bubble, and go down into the mud; and if they find any weak trout in still waters, they consume them. As I say, they are the wolves of the water, for the young trout that are weak. Some time ago I received 25,000 grayling eggs of the grayling of Montana. I hatched them out and found out they could not be handled in a hatchery, and I transferred them to nursery ponds and saved about 5,000. In the nursery ponds I found that I did not have more than 2,000 grayling left, because they had been eaten by the diving beetle.

But I did raise grayling until they were 12 inches long, and kept them and raised them successfully and distributed them in the public waters.

The grayling of Montana have teeth the same as the grayling of Michigan, known as *Thymallus tricolor,* the grayling of Montana known as *Thymallus montanus,* and Alaska grayling as *Thymallus signifer.* I find the raising of any of the grayling impracticable for public waters anywhere in this state, in comparison with the same time devoted to trout.

The next thing our commissioner tried to introduce was the Rocky Mountain whitefish, which is commonly called the grayling by people in Colorado and some parts of Wyoming; but it is a misnomer. They have mouths like the whitefish, and we put them into troughs of the hatchery at Steamboat Springs, and hatch out 300,000. They are abundant in Bear River right alongside the trout; and when I took charge for a couple of months of that hatchery to continue the hatching and rearing of those grayling, I found it a failure, because they should be liberated like whitefish or hatched in jars. However, I saved some of them. We have them here in bottles, and I raised them to that stage. They lived without food for two months. I have kept trout without food, for experiment, in water 36° and kept them three months so that they were nearly starved to death. The whitefish would not feed—they all died off. So we have not yet succeeded in making a success of the reproduction of the Rocky Mountain whitefish. That is all I have to say, except to answer any questions that you may desire to ask.

Mr. Ignatz Baldus, Indianapolis: At the fish hatchery I saw where they were feeding fish liver, lights and lungs, etc. Now, I believe that these fish when they get so that they will eat, would do better if they were put in ponds, where they could get natural food, same as they find in the wild stage, that you will have much stronger and healthier fingerling than under present conditions.

Mr. Land: We have adopted a plan that overcomes the difficulty of the feeding of fingerling in hatchery ponds for any length of time. We cooperate with the railroads and get them to build natural nursery ponds along the lines of their roads on the principal streams throughout this Rocky Mountain state. We turn fish over to them; they have men to look after them; they grow to fingerling size; and they are doing that now. That saves us from raising fingerlings in the hatchery. We cannot afford to raise fingerlings because we could not transport more than a few hundred in a can; while we can transport 2,500 fry such as you see in a hatchery; and two or three weeks they should be in the public streams. They live on microscopic food, and they live on the eggs of insects and on the insects themselves until they become big enough to become cannibals and live on the young of inferior fish. We find that they grow 50% faster after being taken out of troughs. Every fish in this hatchery will be distributed by the end of this month, and so with all the other hatcheries of the state; because we distribute the rainbow and the natives to make room for the brook trout hatch in the fall. We have three hatches a year and we cannot always put them in nursery ponds. Our water supply will not admit of it; but when we plant them in these lakes they live on natural food and do not die and are exterminated only by their enemies.

Mr. Cranston: I want to inquire whether it is a matter of economy or whether it is the best policy that you are advocating. Suppose you had money and water enough, so that you could keep the ponds clean and could feed them, would it not be better?

President: We do not want to get into the discussion of fingerling and fry. We have discussed that question for ten years.

Mr. Land (indicating on map of the United States): To illustrate this to you: Here is the State of Wyoming; draw a line across there, and there were no trout naturally to be found in all those waters that flow into the Atlantic Ocean. That has been all stocked by fry, but never any fingerling raised for planting. Here you have the State of Michigan; that is the whole of the southern part of the state which I have known since 1877, in trout and grayling culture; that has been stocked with rainbow trout and brook trout, all turned into public waters without sacs on, with sac absorbed, but because we lose more by keeping and feeding them. We keep a few of the young trout and raise them to fingerlings and turn them over to the railroad companies, because we want some waters stocked with larger sized fish for immediate result.

Mr. C. W. Willard, Westerly, Rhode Island: I understand that Mr. Land said he was unsuccessful in introducing Montana grayling into public waters.

Mr. Land: My experiments proved unsuccessful.

Mr. Willard: What is the reason?

Mr. Land: The fish cannot be fed and kept in hatcheries; they have to be turned out in nursery ponds where insect life is not destroyed, so that it is not profitable to try to introduce them anywhere except in their native habitat. The gentlemen from Michigan will tell you they are exterminated in that state because they put the trout in some of the Michigan streams and drove the grayling out of the Manistee River. There is only one part of Michigan now where the grayling are in a natural state, and there we found trout side by side with the grayling.

Mr. Willard: Can you state the peculiar characteristics of streams that are necessary for the maintenance of grayling life?

Mr. Land: The only waters that I can call your attention to are the headwaters in Montana of the Yellowstone or Missouri. It is really the Madison River, the headwaters of the Missouri River, and in lakes and streams in Idaho. There you will find the grayling of Montana; the true American grayling were first found in Michigan in the Manistee and the Au Sable (*Thymallus tricolor*), and these are the only places we ever found the grayling, except in Europe. Now, the grayling is so tender that it is impossible to feed it in domestication; and I do not believe it is profitable to undertake to try and perpetuate the species of the grayling in preference to the trout. I think it is a waste of public money. It is very fine for the sportsman and the epicure who like the grayling, the fine texture of its flesh, etc., but unless we can have them brought down by the Government from Alaska and try the grayling of Alaska, the larger size of grayling, I do not believe that it is worth while to even try to perpetuate the grayling.

PRESIDENT: The paper is an excellent one, but we are wandering from the subject of the discussion. We will discuss these subjects later in the question box.

MR. THOMSON: If that explanation had been made after the paper had been read it would have saved a lot of time.

PRESIDENT: I thought everybody knew that we had a question box, where we can discuss subjects not contained in the paper.

MR. H. D. DEAN, Anaconda, Mont.: At the proper time before the meeting is over, I would like to say something about the Montana grayling.

PRESIDENT: We had better take it up under a separate head, when we have the question box to consider.

MR. THOMSON: Let us abide by the question box.

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'11 Wilson, J. S. P. H., Chairman, Board of Inland Game and Fish Commissioners, Auburn, Me.

'10 WINCHESTER, GRANT E., Forest, Fish and Game Commission, Bemus Point, N. Y.

'00 WINN, DENNIS, U. S. Bureau of Fisheries, Oregon City, Ore.

'99 WIRES, S. P., U. S. Bureau of Fisheries, Duluth, Minn.

*'05 WOLTERS, CHAS. A., Oxford and Marvine Streets, Philadelphia, Pa.

'97 WOOD, C. C., Plymouth, Mass.

'11 WORTH, HENRY B., U. S. Bureau of Fisheries, Washington, D. C.

'84 WORTH, S. G., U. S. Bureau of Fisheries, Orangeburg, S. C.

'10 WURZBURG, L., Ketchikan, Alaska.

'09 YERINGTON, EDWARD B., Board of State Fish Commissioners, Carson City, Nev.

'10 YOUNG, CAPT. CARL C., 2 Mt. Vernon St., Gloucester, Mass.

'06 YOUNG, CAPT. JOHN L., Atlantic City, N. J.

'99 ZALSMAN, P. G., Wisconsin Fish Commission, Wild Rose, Wis.

Recapitulation

HONORARY	76
CORRESPONDING	18
ACTIVE (including life members)	533
TOTAL MEMBERSHIP	627

CONSTITUTION

(As amended to date)

ARTICLE I

NAME AND OBJECT

The name of this Society shall be American Fisheries Society. Its object shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of all interests of fish culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II

MEMBERS

Any person shall, upon a two-thirds vote and the payment of two dollars, become a member of this Society. In case members do not pay their fees, which shall be two dollars per year after the first year, and are delinquent for two years, they shall be notified by the treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

The President (by name) of the United States and the Governors (by name) of the several states shall be honorary members of the Society.

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

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, an assistant 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.

In addition to the officers above named there shall be elected annually five vice-presidents who shall be in charge of the following five divisions or sections:

1. Fish culture.
2. Commercial fishing.
3. Aquatic biology and physics.
4. Angling.
5. Protection and legislation.

ARTICLE IV

MEETINGS

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting, or, in default of such action, by the executive committee.

ARTICLE V

ORDER OF BUSINESS

1. Call to order by president.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
    a. President.
    b. Secretary.
    c. Treasurer.
    d. Vice-Presidents of Divisions.
    e. Standing committees.

5. Committees appointed by the president.
   a. Committee of five on nomination of officers for ensuing year.
   b. Committee of three on time and place of next meeting.
   c. Auditing committee of three.
   d. Committee of three on programme.
   e. Committee of three on publication.
   f. Committee of three on publicity.
6. Reading of papers and discussion of same.
   (Note—In the reading of papers preference shall be given to the members present.)
7. Miscellaneous business.
8. Adjournment.

ARTICLE VI

CHANGING THE CONSTITUTION

The constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting, provided at least fifteen members are present at said regular meeting.

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

FORTY-THIRD ANNUAL MEETING

September 8, 9, 10 and 11, 1913

AT

BOSTON, MASSACHUSETTS

NEW YORK, N. Y.
PUBLISHED BY THE SOCIETY
1914

Officers

1912-1913

Elected at the Forty-second Annual Meeting in Denver, Colo., for the ensuing year, including the meeting to be held at Boston, Mass., beginning September 8, 1913:

President	Charles H. Townsend, New York, N. Y.
Vice-President	Henry B. Ward, Urbana, Ill.
Recording Secretary	Ward T. Bower, Washington, D. C.
Assistant Recording Secretary	H. D. Aller, Washington, D. C.
Corresponding Secretary	George W. Field, Sharon, Mass.
Treasurer	C. W. Willard, Westerly, R. I.

Vice-Presidents of Divisions

Fish Culture	James Nevin, Madison, Wis.
Aquatic Biology and Physics	L. L. Dyche, Pratt, Kan.
Commercial Fishing	W. J. Hunsaker, Saginaw, Mich.
Angling	H. Wheeler Perce, Chicago, Ill.
Protection and Legislation	T. S. Palmer, Washington, D. C.

Executive Committee

Daniel B. Fearing, *Chairman*, Newport, R. I.; N. R. Buller, Harrisburg, Pa.; Ernest Schaeffle, San Francisco, Cal.; J. Quincy Ward, Frankfort, Ky.; Dwight Lydell, Comstock Park, Mich.; George W. Miles, Indianapolis, Ind.; George H. Graham, Springfield, Mass.

1913-1914

Elected at the Forty-third Annual Meeting in Boston, Mass., for the ensuing year, including the meeting to be held in New Orleans, La., beginning September 30, 1914:

President	Henry B. Ward, Urbana, Ill.
Vice-President	Daniel B. Fearing, Newport, R. I.
Recording Secretary	Raymond C. Osburn, New York, N. Y.
Corresponding Secretary	George W. Field, Sharon, Mass.
Treasurer	C. W. Willard, Westerly, R. I.

Vice-Presidents of Divisions

Fish Culture	Dwight Lydell, Comstock Park, Mich.
Aquatic Biology and Physics	L. L. Dyche, Pratt, Kan.
Commercial Fishing	Kenneth Fowler, New York, N. Y.
Angling	H. Wheeler Perce, Chicago, Ill.
Protection and Legislation	T. S. Palmer, Washington, D. C.

Executive Committee

Jacob Reighard, *Chairman*, Ann Arbor, Mich.; N. R. Buller, Harrisburg, Pa.; J. Quincy Ward, Frankfort, Ky.; George W. Graham, Springfield, Mass.; George W. Miles, Indianapolis, Ind.; Ernest Schaeffle, San Francisco, Cal.; J. A. Dayries, New Orleans, La.

AMERICAN FISHERIES SOCIETY

Organized 1870

The first meeting of the Society occurred Decemeber 20, 1870. The organization then effected continued until February, 1872, when the second meeting was held. Since that time there has been a meeting each year, as shown below. The respective presidents were elected at the meeting, at the place, and for the period shown opposite their names, but they presided at the subsequent meeting.

PRESIDENTS, TERMS OF SERVICE, AND PLACES OF MEETING.

1.	William Clift	1870-1872	New York, N. Y.
2.	William Clift	1872-1873	Albany, N. Y.
3.	William Clift	1873-1874	New York, N. Y.
4.	Robert B. Roosevelt	1874-1875	New York, N. Y.
5.	Robert B. Roosevelt	1875-1876	New York, N. Y.
6.	Robert B. Roosevelt	1876-1877*	New York, N. Y.
7.	Robert B. Roosevelt	1877-1878	New York, N. Y.
8.	Robert B. Roosevelt	1878-1879	New York, N. Y.
9.	Robert B. Roosevelt	1879-1880	New York, N. Y.
10.	Robert B. Roosevelt	1880-1881	New York, N. Y.
11.	Robert B. Roosevelt	1881-1882	New York, N. Y.
12.	George Shepard Page	1882-1883	New York, N. Y.
13.	James Benkard	1883-1884	New York, N. Y.
14.	Theodore Lyman	1884-1885	Washington, D. C.
15.	Marshall McDonald	1885-1886	Washington, D. C.
16.	W. M. Hudson	1886-1887	Chicago, Ill.
17.	William L. May	1887-1888	Washington, D. C.
18.	John H. Bissell	1888-1889	Detroit, Mich.
19.	Eugene G. Blackford	1889-1890	Philadelphia, Pa.
20.	Eugene G. Blackford	1890-1891	Put-in Bay, Ohio.
21.	James A. Henshall	1891-1892	Washington, D. C.
22.	Herschel Whitaker	1892-1893	New York, N. Y.
23.	Henry C. Ford	1893-1894	Chicago, Ill.
24.	William L. May	1894-1895	Philadelphia, Pa.
25.	L. D. Huntington	1895-1896	New York, N. Y.
26.	Herschel Whitaker	1896-1897	New York, N. Y.
27.	William L. May	1897-1898	Detroit, Mich.
28.	George F. Peabody	1898-1899	Omaha, Neb.
29.	John W. Titcomb	1899-1900	Niagara Falls, N. Y.
30.	F. B. Dickerson	1900-1901	Woods Hole, Mass.
31.	E. E. Bryant	1901-1902	Milwaukee, Wis.
32.	George M. Bowers	1902-1903	Put-in Bay, Ohio.
33.	Frank N. Clark	1903-1904	Woods Hole, Mass.
34.	Henry T. Root	1904-1905	Atlantic City, N. J.
35.	C. D. Joslyn	1905-1906	White Sulphur Spgs., W. Va.
36.	E. A. Birge	1906-1907	Grand Rapids, Mich.
37.	Hugh M. Smith	1907-1908	Erie, Pa.
38.	Tarleton H. Bean	1908-1909	Washington, D. C.
39.	Seymour Bower	1909-1910	Toledo, Ohio.
40.	William E. Meehan	1910-1911	New York, N. Y.
41.	S. F. Fullerton	1911-1912	St. Louis, Mo.
42.	Charles H. Townsend	1912-1913	Denver, Colo.
43.	Henry B. Ward	1913-1914	Boston, Mass.

*A special meeting was held at the Centennial Grounds, Philadelphia, Pa., October 6 and 7, 1876.

CERTIFICATE OF INCORPORATION OF THE AMERICAN FISHERIES SOCIETY

We, the undersigned, persons of full age and citizenship of the United States, and a majority being citizens of the District of Columbia, pursuant to and in conformity with sections 599 to 603, inclusive, of the Code of Law for the District of Columbia enacted March 3, 1901, as amended by the Acts approved January 31 and June 30, 1902, hereby associate ourselves together as a society or body corporate and certify in writing:

1. That the name of the Society is the AMERICAN FISHERIES SOCIETY.

2. That the term for which it is organized is nine hundred and ninety-nine years.

3. That its particular business and objects are 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; to unite and encourage all interests of fish culture and the fisheries; and to treat all questions of a scientific and economic character regarding fish; with power:

a. To acquire, hold and convey real estate and other property, and to establish general and special funds.

b. To hold meetings.

c. To publish and distribute documents.

d. To conduct lectures.

e. To conduct, endow, or assist investigation in any department of fishery and fish-culture science.

f. To acquire and maintain a library.

g. And, in general, to transact any business pertinent to a learned society.

4. That the affairs, funds and property of the corporation shall be in general charge of a council, consisting of the officers and the executive committee, the number of whose members for the first year shall be seventeen, all of whom shall be chosen from among the members of the Society.

Witness our hands and seals this 16th day of December, 1910.

Seymour Bower	(Seal)
Theodore Gill	(Seal)
William E. Meehan	(Seal)
Theodore S. Palmer	(Seal)
Bertrand H. Roberts	(Seal)
Hugh M. Smith	(Seal)
Richard Sylvester	(Seal)

Recorded April 15, 1911.

CONTENTS

PART I

BUSINESS SESSIONS

Transactions of the American Fisheries Society

Forty-third Annual Meeting, held at Boston, Mass., Monday, Tuesday, Wednesday and Thursday, September 8, 9, 10 and 11, 1913.

Monday, September 8, 1913.

The meeting was called to order by the President, Dr. Charles H. Townsend, of New York City. The President then introduced Hon. Eugene N. Foss, Governor of Massachusetts, who made an address welcoming the Society to the State and expressed the wish that the meeting would prove to be both pleasant and profitable. President Townsend responded briefly, thanking Governor Foss on behalf of the members of the Society for his presence at the meeting and for his cordial greeting.

REGISTERED ATTENDANCE.

The President then ordered the roll-call of members to be taken. Sixty-seven members were registered for the meeting, as follows:*

Adams, Wm. C.
Babbitt, J. O.
Belding, David L.
Blain, James
Bower, Seymour
Buller, N. R.
Chambers, Fred W.
Corliss, C. G.
Crandall, A. J.
Dayries, J. A.
Dean, H. D.
DeRocher, J. D.
Dinsmore, A. H.
Dyche, L. L.
Embody, Geo. E.
Evans, Barton D.
Fearing, Daniel B.
Fearing, Mrs. Daniel B.
Field, George W.
Field, Irving A.
Foster, F. J.
Graham, A. R.
Graham, E. A.
Graham, Geo. H.
Hahn, E. E.
Hayford, Chas. O.
Herrick, Geo. H.
Hitchings, Frank E.
Hubbard, Waldo F.
Huntsman, O. G.
Hurlbut, H. F.
Johnson, R. S.
Kopplin, Philip
Locke, E. F.
Lydell, Dwight
May, Wm. L.
Merrill, Arthur
Merrill, M. E.

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*Addresses will be found in the list of members at the back of this volume.

Miles, Geo. W.
Miller, Frank
Monroe, Otis
Morton, Wm. P.
Mowbray, Louis L.
Neal, Walter I.
Nesley, Chas. H.
Nichols, J. T.
Pope, T. E. B.
Porter, R.
Prince, E. E.
Race, Edward E.
Reighard, Jacob
Richards, G. H.
Rider, H. A.
Rogers, Jas. B.
Smith, H. C.
Starr, W. J.
Story, John A.
Thomas, Adrian
Titcomb, John W.
Townsend, Chas. H.
Viles, Blaine S.
Ward, Henry B.
Ward, J. Quincy
Willard, C. W.
Wilson, C. H.
Woods, John P.

Mr. Willard, Rhode Island: Inasmuch as a number of gentlemen present have applications for membership on file, I suggest that their names be voted on at once in order that they may participate in this meeting.

President: The Treasurer will read the list of applications for membership.

The following list of 132 names was presented and voted upon:

NEW MEMBERS*

Adams, Wm. C.
Alexander, M. L.
Anderson, Carl A.
Baldwin, Marcus D.
Ball, Frank H.
Belding, David L.
Bell, J. C.
Bennett, Chas.
Benson, John T.
Benton, A. W.
Berg, George
Bickford, W. M.
Bickley, Chas.
Blackford, Chas.
Blain, James
Blamey, John F.
Callaway, Fuller E.
Casting Club de France
Chambers, F. W.
Chapman, L. Dana
Churchill, Winston
Coles, Russell J.
Cook, Austin
Crandall, A. J.
Curran, Wm. E.
David, Geo. E.
Davis, H. C.
Dayries, J. A.
Denison, A. P.
De Rocher, Jas. D.
Dickinson, F. H.
Dickinson, P. A.
Dodge, Leslie G.
Downey, Ben
Drew, S. S.
Durkin, D. L.
Embody, Geo. C.
Estes, B. E.
Flyfishers Club
Gardner, John W.
Gerry, Peter G.
Gerry, Robert L.
Getz, Norman
Goffin, Robert A.
Goodspeed, L. B.
Goodwin, O. C.
Gourville, J. H.
Graham, E. A.
Guerin, Theophile
Guptil, Geo. L.

*For addresses see list of members at back of volume.

Halter, Lawrence
Harriman, Averil
Hayford, Robert E.
Heiman, A. J.
Herrick, Geo. H.
Higgins, Alf. S.
Hitchings, Frank E.
Hoffses, Elvin J.
Hoffses, G. Raymond
Hover, Herbert
Howard, Arthur D.
Howes, Elijah S.
Huntsman, A. G.
Ingalls, Geo. M.
Jones, E. Lester
Johnson, E. H.
Johnson, Henry J.
Johnston, Cassius A.
Kinney, M. J.
Knight, H. J.
Lee, Harvey S.
Lowell, Carleton W.
MacCallum, G. A.
McIntyre, Douglas N.
McLain, W. S.
Maris, Jas. D.
Mathewson, E. P.
Merrill, Arthur
Mershon, W. B.
Mixter, Sam'l J.
Monroe, Otis D.
Monroe, Wm.
Moore, Alfred
Murphy, C. H.
Neal, Walter I.
Newport Free Library,
Newport Historical Society,
Oakes, Wm. H.
Ofthsun, T. O.
O'Hara, Joseph
Page, W. H.
Patterson, A. G.
Poole, Gardner
Purdum, Jas. K. P.
Redwood Library,
Reidel, F. K.
Reynolds, Jas. A.
Rhines, Wallace D.
Robirds, Geo. L.
Roach, Edwin R.
Rose, W. G.
Russell, J. R.
Ryan, Calvin D.
Sachs, Jas. G.
Santa Barbara Public Library,
Schleicher, R. O.
Schwartz, Benjamin
Seagrave, Arnold
Shelford, Victor E.
Sherwin, Gerald
Singleton, J. Ernest
Smith, Herbert C.
Stapleton, J. J.
Sullivan, Walter E.
Thaw, August B.
Thomas, Adrian
Tichenor, A. K.
Timson, Wm.
Trexler, Col. Harry C.
Triggs, Chas. W.
Turner, Chas. C.
Tuxbury, Chas.
Tyson, Jas. W.
Varden, Geo. S.
Watts, A. E.
Weil, Walter G.
Welsh, Wm. W.
Westerfeld, Carl
Westermann, J. H.
Winter, J. H.
Wisner, J. Nelson
Woods, John P.

President: It is most gratifying to have such a number of applications for membership. Nothing like it has ever been known in the history of the Society.

The President has to report that the annual volume of Transactions is probably on the way from the press. In the absence of the Recording Secretary, Mr. Ward T. Bower, in Alaska, the work of getting out this volume was turned over to his associate in the United States Bureau of Fisheries, Mr. H. D. Aller, who finally became dismayed at the task of editing the large mass of manuscript and requested help of me. Papers sent to members for correction were not always returned promptly, so the volume was very much delayed. It seemed advisable to do some editing and to blue-pencil some of the irrelevant matter in the discussions. This was done with the approval of members of the Executive Committee.

We have been publishing our report rather carelessly, giving the discussions *in toto*, which probably is not wise, and a good deal of matter could be left out if this were placed in the hands of a careful editorial committee. Besides, the society is not prosperous enough to do so much printing, and it is necessary for us to condense a little where it can be done without harm to our volume. I hope that a little later on in the meeting we will be able to decide upon the best course to pursue in this matter.

It seems desirable, also, that we should consider later at this meeting the matter of compensating the Secretary, because the labor is too great for any one man to undertake for nothing, and besides, the Secretary is subject to criticism when he attempts to edit papers and there are always some papers which have meat in them but which are too voluminous and which really need editing.

REPORT OF THE RECORDING SECRETARY.*

To the Officers and Members of the American Fisheries Society:

The chief duties of this office have had to do with the preparation of the report of the Denver meeting and publishing same in the annual volume comprising the Society's Transactions. The usual correspondence incident to the Society's activities has been given proper attention. No Assistant Secretary was elected at the last meeting, the selection of this office being left to the Secretary. Accordingly Mr. Henry D. Aller, of the Bureau of Fisheries, Washington, D. C., was named to fill this office. The Society was fortunate in Mr. Aller's acceptance of this position, as in March it became necessary for the Secretary to proceed to Alaska for a protracted period, and most of the concluding work of getting out the Transactions devolved upon the Assistant Secretary. As there may be a repetition of extended absence from headquarters at Washington, your Secretary feels that under the circumstances he cannot longer serve the Society usefully in any capacity as an active officer.

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*Owing to the absence of the Secretary in Alaska, this report was not presented at the meeting, but is inserted here for the information of the members of the Society. *Editor.*

Prior to the Secretary's departure, most of the material for the report was made ready for the printer. In this connection, it seems appropriate to state that discussions, particularly in the business section of the Transactions, are condensed and epitomized much more than has been the custom during recent years. In view of the deficit in the Treasury, this course was adopted for the purpose of saving as much as possible on the cost of getting out the Transactions. Also for this reason less expensive paper, though of substantial quality, was selected. The contract was again let to the W. F. Roberts Company, of Washington, D. C.

During the year reports have been sold in the sum of $34.07. As ordered by the Society at the 1911 meeting, the charge has been $1.00 per volume, except the Fortieth Anniversary issue (1910) for which the rate has been $2.00 per copy. It is unfortunate that a number of requests for various issues could not be supplied owing to the scarcity of copies other than for some six years back. Reports in the hands of the Secretary are as follows:

1895	1	1904	62
1896	1	1905	1
1897	1	1906	93
1898	1	1907	86
1899	1	1908	118
1900	3	1909	136
1901	1	1910	114
1902	4	1911	128
1903	0	1912	230

The raising of funds wherewith to liquidate the deficit of about $500 at the beginning of the year has been an important feature since the last meeting. Circulars have been sent out during the year, asking for donations; also asking that life membership be taken out. As a result of these appeals donations were received by the Treasurer in the sum of $197.75 and twelve life memberships at $25 each were paid for, thus bringing in a sum of nearly $500. The origin of the indebtedness dates back to the unusual expenditure of approximately $1,500 for publishing the Fortieth Anniversary number issued in 1910, a volume of 469 pages.

During the year the following members have resigned:

Paul North ('02), Cleveland, Ohio.
Ethel M. Smith (Miss) ('10), Washington, D. C.
Oregon Milton Dennis ('04), Baltimore, Maryland.
Dr. Oliver L. Jones ('95), New York, N. Y.
Prof. James L. Kellogg ('98), Williamstown, Massachusetts.
C. A. Reed ('03), Santa Cruz, California.
Dr. H. C. Bumpus ('98), Madison, Wisconsin.
Nelson Bailey ('04), Wells River, Vermont.
Dr. D. W. Green ('02), Dayton, Ohio.
Henry Russell, ('97), Detroit, Michigan.

Since the last meeing the demise of the following members has been reported:

Livingston Stone, Swissvale, Pa. Charter member. Died December 24, 1912.

S. L. French, ('11), Dallas, Texas. Died November 8, 1912.

H. G. Saunders ('02), Chattanooga, Tenn.

Chester K. Green ('04), U. S. Bureau of Fisheries, Cape Vincent, N. Y. Died, November 5, 1913.

John W. Fredrum ('11), Denver, Colo. Died January 9, 1913.

H. D. Goodwin ('08), Milwaukee, Wis.

During the year accessions to the rolls of active membership have numbered 132. The active membership is now 613; total membership 706.

In bringing to a close his tenure of office, your Secretary desires to express his sincere appreciation of the honor which has been accorded him for the opportunity of serving an organization of the character and high standard of the American Fisheries Society.

Respectfully submitted,

WARD T. BOWER,
Recording Secretary.

JUNEAU, ALASKA, September, 1913.

REPORT OF THE TREASURER.

To the American Fisheries Society:

I herewith submit my annual report as Treasurer from September 3, 1912, to Sepember 8, 1913.

RECEIPTS

1912-13			
	Sale of reports	$ 34.07	
	Yearly dues	999.00	
	Life membership fees	300.00	
	Donations from members	197.75	
			$1,530.82

EXPENDITURES

1912			
Sept. 5.	Balance due Treasurer	$7.99	
" 5.	G. H. Graham, printing, etc., Denver	6.85	
" 16.	C. J. Butler, P. M. envelopes	10.68	
" 24.	W. F. Roberts Co., Reports and mailing	949.60	
Oct. 11.	Clerical services	3.50	
" 11.	C. J. Butler, P. M. envelopes	10.68	
1913			
Jan. 28.	J. H. Rush, lettering certificates	27.20	
Feb. 1.	Registry and postage, Receipt books	.38	
" 6.	J. H. Rush, lettering certificates	2.40	
" 6	McDermott & Goodwin, stenography	182.00	
Mar. 29.	Ward T. Bower, Sec., postage, etc.	19.95	
June 4.	C. J. Butler, Postmaster, envelopes	10.68	
Aug. 4.	J. H. Murphy, printing	1.50	
" 7.	Irving Press, New York, printing	11.15	
Sept. 4.	Irving Press, New York, printing	25.00	
" 4.	Dr. C. H. Townsend, Pres., postage, etc.	19.72	
			$1,289.28
Sept. 8.	Balance cash on hand		241.54
			$1,530.82

Respectfully submitted,

C. W. WILLARD, *Treasurer.*

Westerly, R. I., Sept. 8, 1913.

This report was accepted and referred to the Auditing Committee.

For the information of the members, the Treasurer made the following explanations of the financial status of the Society:

"I will state, gentlemen, that while it may appear by this that we are out of debt, and have cash on hand to the extent of $241.54, it is not so. The $949 which appears to have been paid for the reports and other expenses here, with the exception of a few items have been for the meeting of 1911 instead of the meeting held a year ago. We are in debt at the present time for the publication of the Annual Report for 1912, which is now being mailed to the members.

"During the past year a printed letter calling on members for donations in the sum of one dollar and upwards, to wipe out the indebtedness of the Society, has been circulated with the result that $257.75 have been donated for this purpose. The list of donors follows:*

Contributing $1.00,—August J. Anderson, J. F. Anderson, James Annin, Howard S. Bailey, W. O. Buck, Wm. A. G. Buller, C. H. Bushman, R. E. Coker, Thos. M. Darrah, H. D. Dinsmore, Kelley Evans, I. A. Field, Chas. W. Green, E. E. Hahn, W. K. Hancock, G. Hanson, J. R. Hayes, Chas. O. Hayford, E. D. Hemmingway, W. P. Herrick, T. D. Hobart, Glen C. Leach, Chas. E. Lewis, Geo. N. Mannfeld, J. P. Marks, R. R. Meentz, G. J. T. Meyer, Geo. T. Mills, M. G. Munly, H. Wheeler Perce, T. E. B. Pope, E. E. Race, Lewis Radcliffe, H. D. Reed, Waldo Schmidt, Wm. P. Seal, Marion G. Sellers, Frank A. Shebley, John A. Story, W. H. Thomas, W. P. Thomson, Jas. N. Tierney, C. H. Walters, Edward C. Whitman, Grant E. Winchester, S. G. Worth, and E. P. Yerrington.

Contributing $2.00,—Geo. L. Alexander, E. M. Ball, Jas. T. Barron, J. H. Bissell, F. H. Britton, C. G. Corliss, C. K. Cranston, S. W. Downing, Barton D. Evans, C. F. Fowler, Philip Hartman, W. F. Hubbard, Chas. Lay, Lewis H. Smith, A. T. Vogelsang and Bryant Walker.

Contributing $5.00,—John P. Babcock, S. Thurston Ballard, S. P. Bartlett, E. A. Birge, Wm. H. Boardman, Edwin C. Kent, Robert T. Morris, J. F. Moser, Henry C. Smith, Hugh M. Smith and C. C. Wood.

Contributing other amounts,—$25.00, N. R. Buller; $15.00, Chas. H. Townsend; $10.00, Kenneth Fowler, North Alaska Salmon Co., by J. P. Haller, R. Tyson White and John P. Woods; $8.00, N. B. Church; $6.00, W. J. Hunsaker; $4.00, H. F. Moore; $3.00, Seymour Bower, P. J. Engelbrecht, W. E. Meehan, Henry T. Root, J. W. Titcomb, Henry B. Ward, and W. P. Wires; $2.50, North Alaska Salmon Co.; $1.25, George Morcher.

PRESIDENT: I feel that the American Fisheries Society will be able to take care of itself. It will probably cease

* This list is corrected to March 1, 1914.—*Editor.*

to distribute its rather expensive volume to members who are in arrears, and the volume can be edited in a manner which will make it less expensive.

I have to announce the arrival of the Mayor. Gentlemen, we have with us this morning another distinguished visitor, Hon. J. F. Fitzgerald, Mayor of Boston, who wishes to extend a word of welcome.

Mayor Fitzgerald gave the Society a cordial welcome to the city and made some interesting remarks on the increase in price of fishery products in Boston since his boyhood. The suggestion was made that ocean liners equipped with wireless telegraph apparatus might be encouraged to aid the work of the fishermen by reporting the location of schools of mackerel they chance to pass through. The Mayor further recounted some of his experiences while a member of Congress in the attempt to secure the passage of legislation for the protection of the lobster, and stated that the best means of securing the passage of any measure consists of personal solicitation of members of Congress while supplying them at the same time with definite information as to the value of such legislation.

President Townsend presented the thanks of the Society to Mayor Fitzgerald for his address. Mr. Daniel B. Fearing was then called upon to give the report of the Executive Committee.

REPORT OF THE EXECUTIVE COMMITTEE.

MR. FEARING: During the year, at the approval of the Executive Committee, as Chairman, I sent out a request for funds from the Society to aid the Treasurer. I sent at my own personal expense more than six hundred communications, enclosing a stamped envelope addressed to Ward T. Bower, Secretary, and a printed postal card, which only had to be filled in and sent. To these communications that I sent out, there were eighteen members that were good enough to answer; but, out of the eighteen members that answered, I got eight life memberships, and seventeen or eighteen annual members, with a donation of ten dollars from one man and a dollar from another.

The Executive Commitee have had two short meetings and before the end of this meeting will suggest certain measures which they think the society ought to act upon in regard to the distribution of the transactions and in regard to the revision of the membership, which may be brought before the Committee on Resolutions later.

The Society then adjourned for the morning.

The afternoon was spent in visiting the Aquarium in South Boston, following which a tour was made through the parks of the city at the invitation of the Boston Park Commission.

The evening session was called to order at 8 o'clock and the President announced the following committees:

Nominations: George W. Field, N. R. Buller, J. W. Titcomb, J. Q. Ward, W. L. May.

Place of Meeting: J. P. Woods, C. W. Willard, W. C. Adams.

Auditing: G. W. Miles, Seymour Bower, Dwight Lydell.

Program: H. D. Dean, F. Miller, C. G. Corliss.

Publication: R. C. Osburn, Bashford Dean, J. T. Nichols, T. H. Bean.

Publicity: H. W. Perce, G. H. Graham, T. S. Palmer, G. E. Jennings.

Resolutions: Jacob Reighard, E. E. Prince, L. L. Dyche.

PRESIDENT: It has been difficult to get the annual volume edited this year, and I think we cannot do better than to get this Publication Committee all located near together and for that reason I have appointed members living in or near New York City.

PRESIDENT: I have a letter from the United States Commissioner of Fisheries, Dr. Hugh M. Smith, who sends a paper to be read and also his best wishes for a successful meeting. Will Dr. George W. Field kindly read Dr. Smith's paper, which is entitled, "The Need for a National Institution for the Technical Instruction of Fisherfolk."

Following the reading of this paper Dr. Field moved the appointment of a committee to aid in furthering any action looking toward the consummation of this matter. Adopted.

The President later appointed Prof. Jacob Reighard, Prof. E. E. Prince and Prof. Bashford Dean to this committee.

Tuesday, September 9, 1913.

The entire morning session was occupied with the reading and discussion of two papers. E. E. Prince,—"A Perfect Fish Pass: Some suggestions as to the Defects in Fish Passes and How to Overcome Them." L. L. Dyche,—"Possibilities of an Acre Fish Pond."

Owing to the number of papers on the program it was voted to abandon the excursion which had been planned for the afternoon in order to devote the time to the reading and discussion of papers.

Adjourned.

At the afternoon session the time was devoted entirely to the program, which was taken up in the following order:

C. H. Townsend,—"The Private Fish Pond—A Neglected Resource."

L. L. Dyche,—"One Year's Work at the Kansas State Fish Hatchery."

J. P. Snyder,—"Notes on Striped Bass" (read by H. D. Dean).

Jacob Reighard,—"Improvements of Fishing Through a Knowledge of the Breeding Habits of Fishes."

At 8 o'clock in the evening the Society again convened for the reading and discussion of the following papers:

N. R. Buller,—"The Work of the Pennsylvania Fisheries Department."

D. L. Belding,—"Conditions Influencing the Growth of Clams (*Mya arenaria*)."

Wednesday, September 10, 1913.

PRESIDENT: I have received a letter from the United States Commissioner of Fisheries containing the offer of a fund of $250 for the use of this Society. If the members of the Society will please do a little thinking about this matter, I will bring it up again for discussion this afternoon, for it is very important.

We have letters from old members who have been in the Society for many years. Chas. G. Atkins, of Maine, sends his paper and regrets that he will not be able to attend the meeting. Our very dear friend, Professor Forbes, head of the State Laboratory of Natural History in Illinois, also regrets that he is unable to be with us.

Another letter from the Gloucester Master Mariners' Association on behalf of the Master Mariners, reads as follows: "I tender to you the use of our rooms in Gloucester. There is plenty of room to hold meetings." It is signed by Mr. Stapleton, Secretary. The Society will probably not have time to go down as a body.

A letter from the Alaska Packers' Association in San Francisco, suggests that we might invite the larger fishery associations of the country to become life members of this Society, and that they are willing to subscribe now. We need more members and a larger income than we get from our two dollar dues, and, if the members of the Society will make it their business to speak to some of the managers of fishery firms, it is quite likely that we can get some very desirable members and considerable in the way of funds.

This Society is indebted to Mr. Daniel B. Fearing for a magnificent index to the publications of the American Fisheries Society, covering the first forty volumes of the annual Transactions. This has been prepared very carefully by Mrs. C. C. Gardner of Newport, under Mr.

Fearing's direction and has been under way for two or three years. Will Mr. Fearing please explain.

MR. FEARING: The work is all done with the exception of a few corrections and verifications and will then be ready for the printer. It is an index in the simplest form, going alphabetically through all the volumes. If one desires to look up any fish, he can easily find where it is discussed. For instance on the subject of fish-ways there are twenty or thirty articles; trouble in regard to fish-ways established by the United States Government; discussion on fish-ways; Grand Lake Stream fish-ways, etc.

This will be ready for the printer after a few days work in verifying certain entries and having it re-typed after the corrections are made. I will then send it to the President or Secretary in the hope that some time the Society may be able to publish it. (Applause).

Prof. Reighard, as Chairman of the Committee on Resolutions, moved a vote of thanks to Mr. Fearing and Mrs. Gardner for the invaluable service rendered to the Society and to all persons interested in fish and fisheries by the preparation of the index.

The resolution was adopted.

President Townsend commented on the great value of such indexes and expressed the hope that the Society would soon be able to publish it.

The following papers were then read and discussed:

I. A. Field:—"The Development of the Salt Water Mussel Industry."

J. Reighard:—"A Plea for the Preservation of Records Concerning Fish."

E. E. Prince:—"Some Animals and Conditions Inimical to Fish Eggs and Larvae in the Sea."

G. W. Field:—"The Alewife Fishery of Massachusetts."

Col. Joseph H. Acklen was called on to address the Society and responded briefly.

PROF. WARD, of Illinois: Before we adjourn, I wish to call to the attention of members of the Society a matter concerning which I have not consulted our worthy President. I feel it is necessary to make this statement in advance.

Last year the Society expressed itself very positively regarding the matter of the Alaska Fur Seal Fisheries and the part which the Bureau of Fisheries and the Department of Commerce and Labor should have in the decision of that question.

Some of you remember that, in the course of the winter, Dr. Townsend, our President, was called to testify at Washington. The testimony which he gave as a scientific expert did not suit certain political gentlemen, and they proceeded to impugn his testimony not on scientific grounds, but by charging him with various forms of dishonesty, and so forth and so on. For a short period Dr. Townsend enjoyed newspaper notoriety that seldom falls to a scientific man. Those personally acquainted with him were sure that there was something not explained in the paper, but I think it very likely that there were other persons in the country, who did not have such knowledge of his character and standing as a scientific man, and I do know that some persons were astonished and perhaps grieved at the appearance of duplicity in his conduct shown, or apparently shown, by this testimony. The New York Zoological Society took the matter seriously, investigated it very carefully, and, in a document, called attention to certain facts. The charges that were made were contained in the report of the majority of a Committee of the House of Representatives; the report was given a wide circulation before it was acted upon by the full committee. The rest of the committee presented a minority report in direct opposition to that of the majority.

The only references to Dr. Townsend were simply distortions made for political purposes in connection with the discussion before Congress.

After a most careful investigation the New York Zoological Society adopted unanimously the report of the minority, which states in very explicit terms that *none* of these charges were true.

It seems to me particularly appropriate to bring the matter before this body at this time: to furnish, in the first place, a specific statement to you that the charges have been investigated and declared groundless; and, secondly, would it not be proper that this Society should express distinctly its confidence not only in the scientific standing but also the integrity of our President?

I should like to move that the Society, at this time, desires to express its fullest confidence in President Townsend, and its regret that the press should have been called upon to circulate such distorted statements regarding the facts in this case.

MR. BOWER, of Michigan: I will take the liberty of putting the question before the Society, inasmuch as the President would hardly wish, perhaps, to bring this up. I would like to say we have acted together in this matter. Our President has been unjustly attacked, simply because certain selfish interests could not control him; he has been assailed because he represented fearlessly the position of the U. S. Bureau of Fisheries, and I hope that this Society, by a unanimous vote, will show its appreciation of their confidence in him. Those that favor this motion will signify it by rising.

Carried unanimously.

DR. TOWNSEND: I have nothing further to say on the fur seal matter, except that I have been in this unfortunate fight for twenty-five years, and I am still in it. Our report, which has just come out, contains my remarks of last year, and I have made similar remarks which have been printed elsewhere. I am still putting myself on record regarding what is going to happen on the Fur Seal Islands. This move of the House Committee was really not against me but was an attempt to discredit the Government control of the Islands, so that the Islands could be leased to private parties. The next move of the seal lobby will be to introduce a bill to provide for the leasing of the fur seal fishery.

Adjourned.

The Wednesday afternoon session was devoted entirely to business, and the following papers remaining on the program were, by vote of the Society, read by title and referred to the Publication Committee:

A. S. Bickford,—"Notes on the Montana Grayling."

Wm. P. Seal,—"Suggestions of Possible Interest to the American Fisheries Society and to Fish Commissions."

F. F. Dimick, "The Fish Trade Organizations."

Phil. C. Zalsman, "Experiments in Fish Culture While in the Employment of the Michigan and Wisconsin Fish Commissions."

Charles H. Nesley, "Small Mouth Black Bass."

J. T. Nichols, "Concerning Young Bluefish."

Charles G. Atkins, "The Atlantic Salmon."

W. E. Meehan, "The Establishment of an Aqarium in Philadelphia."

Henry C. Rowe, "Oysters; A Desirable Food."

PRESIDENT: No action has yet been taken on the letter from the United States Commissioner of Fisheries relative to his fund of $250 to be administered by the Society.

Without discussion it was moved and carried that the matter be referred to the Executive Commitee.

PRESIDENT: The Chair has to suggest the desirability of revising our list of honorary members. The Society is not rich enough to give away fifty volumes a year to the governors of the states, which may go into official waste-baskets. The active members not in arrears are entitled to them.

MR. FEARING, of Rhode Island: Might I suggest that the distribution of the annual reports be left to the discretion of the Secretary and Treasurer? There are no specific instructions in the By-laws that every member of the Society shall receive the Transactions. If we remove the Governors of the States and the President of the Nation from the list that will relieve us of 49 copies, which is quite a saving.

PROF. WARD, of Illinois: This is a rather heavy burden to throw upon our Secretary and Treasurer and I think that the two, while practically doing the work, should be shielded behind the Executive Committee.

After considerable further discussion, Professor Ward presented the following motion which was seconded by Mr. Fearing:

Moved that the Secretary and Treasurer dispose of the annual Transactions with the approval of the Executive Committee. Motion carried.

AMENDMENTS TO THE CONSTITUTION.

PROF. WARD: Two subjects have been under discussion in special meetings of the Society and I was requested to draft the present amendments covering these items. As the constitution now stands, no library nor club can subscribe for the Transactions, and yet I am sure you will all agree that we are anxious to sell as many as possible. We propose to amend Article II by adding the following:

Any library, sporting or fishing club, society, firm or corporation may upon two-thirds vote and the payment of the regular annual fee become a member of this Society and entitled to all its publications.

Moved and carried that this clause be added to the Constitution.

PROF. WARD: The second item should be the paragraph following the one just adopted. Add to the Constitution these words:

Any person, society, club, firm or corporation, on approval by the Executive Committee and on payment of $50.00 may become a patron of this Society with all the privileges of a life member and then shall be listed as such in all published lists of the Society. The money thus received shall become a part of the permanent funds of the Society and the interest alone be used as the Society shall designate.

You will recall that we have been offered a nucleus of $250.00 for a permanent fund and this furnishes a way in which this permanent fund can be slowly advanced to a point where it can be a great benefit and credit to the Society.

This second amendment was also adopted by the Society as a part of the Constitution.

Mr. Nesley inquired whether any back volumes of the Transactions could be secured. The President informed him that they could be purchased from the Secretary.

Mr. Miles made the report for the Auditing Committee.

REPORT OF AUDITING COMMITTEE.

In the absence of the Secretary and of any records, the Auditing Committee has not been able to make up a list of the membership and the number who have paid dues; but the Committee has checked the vouchers for expenditures with the report made by the Treasurer and finds it correct.

Respectfully submitted,

GEO. W. MILES,

S. BOWER,

DWIGHT LYDELL.

Auditing Committee.

This report was adopted.

REPORT OF COMMITTEE ON RESOLUTIONS.

PROF. REIGHARD: The Committee on Resolutions has a number of Resolutions to present. It has interpreted its powers as being confined to the presentation to the Society of those resolutions concerning its relations to things outside of the Society, and has not undertaken to present resolutions referring to its internal affairs. Those should come from the Executive Committee or other members on the floor. The first one is an appreciation of courtesy:

I. RESOLVED: That the American Fisheries Society hereby expresses its appreciation of the many courtesies extended to it by the Governor and Council of the Commonwealth of Massachusetts, by the Mayor and Park Commission of the City of Boston, by the Massachusetts Fish and Game Commission and by the various organizations of Boston fish dealers. It desires to thank them individually and collectively for their part in a most successful meeting and directs that copies of this resolution be transmitted to them.

Resolution adopted.

II. *Whereas* the fisheries of this nation are an asset so essential to the well-being of the people and the national fishery resources are amenable to intelligent conservation and wise exploitation just as are our agricultural resources;

BE IT RESOLVED that the American Fisheries Society expresses its great satisfaction at the appointment of Dr. Hugh M. Smith to the National Commissionership, assuring him and his associates in the Bureau of Fisheries, Washington, D. C. of loyal support in every effort to maintain and develop the marine and fresh-water fisheries.

Resolution adopted by rising vote.

III. *Whereas* with the vast increase in the population and the consequent growing demand for greater food supplies, the cost of living has so augmented as to attract serious and wide-spread public attention;

BE IT RESOLVED that the American Fisheries Society urges private individuals, civic and other corporations, and the various Fish Commissions to study and to develop the resources of public and private lakes, ponds and streams and to more fully utilize them for the rearing of food fishes.

Resolution adopted.

IV. *Whereas* Congress enacted legislation relative to migratory birds;

BE IT RESOLVED that this Society favors legislation in regard to fishes which migrate between States, the importance to the people of the conservation of fishery resources being not inferior to that of the preservation of migratory birds, neither of which should be impaired for private gain to the disadvantage of the people. The Society, therefore, endorses the following bills now pending in the United States Congress: H. R. 7774 and H. R. 7775.

V. *Whereas*: The fisheries of certain States and Provinces are being immensely depleted by unwise local regulations and whereas the whitefish fishery, among others is of special importance in the question of the food fish supply of this continent,

BE IT RESOLVED, that this Society urge upon every citizen and every State and Province, the increasing importance of adequate protection of this valuable food fish product and the development of whitefish fisheries under wise and competent Dominion, National and State direction and authority. And be it further

RESOLVED: That this Society recommends and gives its endorsement to that part of the International Agreement on the Great Lakes regarding size limits of the common whitefish, to wit, a minimum size limit of two pounds in the round, and urge that in the formulation of regulations regarding the protection of this species, this standard method of weight only shall be used.

MR. C. H. WILSON, of New York: I want to speak regarding New York State. Ninety-five per cent of the fish we use in New York State comes from states bordering on the Great Lakes and Canada. Up to seven years ago we did not have a protective law regarding whitefish in the Great Lakes. In enacting legislation in harmony with the treaty the two-pounds-in-the-round law was passed, but without being operative owing to the non-action of the State Commissioner. The two-pound law was thrown out and the 12-inch law passed in its stead. We traveled under this 12-inch whitefish law for one year, when the Chairman of the Conservation Commission of New York State appeared before the Senate Committee and stated to them that we had been a dumping ground of immature and illegally taken whitefish all over the State. In Manitoba there were several carloads of immature whitefish ready when New York passed the 12-inch law. These were shipped in and I bought whitefish eight and nine inches long, taken out of Manitoba lakes in 1910-11, that, when thawed out, fell apart.

I have been in this fight on the whitefish question for seven years and I ask you to give us your endorsement of this two-pound limit. There is another resolution dealing with the whitefish and if we may have it read I will not ask for more time now.

PRESIDENT: The Committee on Resolutions informs me that these two resolutions can be considered together. Is the Society prepared to hear the second resolution?

PROF. REIGHARD: The second resolution provides for the appointment of a committee to determine the length and weight of all whitefish; the idea being that it is easier to measure fish than to weigh them, and if the length of the two-pound fish is known, it will be easier to enforce the law.

VI. BE IT RESOLVED: That the president of this Society shall appoint a committee of five, composed of members from Canada and the United States actively engaged in whitefish fishery operations and others familiar with the life and habits of the fish. Said committee to determine the relative sizes of the same as shown in a measure of length and a measure of weight. Such committee to report at the next annual meeting of the Society.

The Committee on Resolutions has voted to submit both of these resolutions. If it is the opinion of the Chair, they may be considered together to save time.

PRESIDENT: What is the pleasure of the Society?

MR. WILSON: This law has been violated repeatedly. I have bought the fish myself. In regard to this second resolution, the question of knowing just how much a two-pound fish will measure is an absolute necessity. My State changed the regular method of measurement by pounds to a measurement by inches with results which I have tried to explain. Mr. S. W. Downing of the Put-in Bay hatchery had under observation 6,500 whitefish. He sorted out 200 of the smallest fish, and not one fish of this 200 sustained the contentions of the New York State Commission as voiced by parties interested.

PRESIDENT: Is the Society prepared to deal with these resolutions? If they are adopted the Chair is willing to appoint the committee recommended by the second resolution.

Moved and carried that both resolutions be adopted.

PROF. REIGHARD: May I make one suggestion in regard to this second resolution? The members of this committee should adopt a uniform method of measuring whitefish. The method of measuring is from the end of the snout along the side to the base of the tail fin, but the tail fin is sometimes included.

PRESIDENT: The Chair appoints as members of this committee: Messrs. S. W. Downing, J. Reighard, E. E. Prince, A. G. Huntsman and S. Bower, who will please report in regard to this matter at the next meeting.

MR. FEARING: I have to offer two resolutions relating to the affairs of the Society.

I. RESOLVED: That the Secretary be instructed not to send copies of the Annual Transactions to members in arrears for dues.

Resolution adopted.

II. RESOLVED: That the Recording Secretary be given annually $50.00 in addition to necessary expenses of the office.

I would like to speak a word in favor of this. It has been the custom of the Society up to the present time to return the Recording Secretary nothing for his labor. His work has been purely a labor of love and is more than the Society ought to ask a man to give.

MR. SEYMOUR BOWER: As I understand it, the publication of the Proceedings is now referred to the Publication Committee. That will take 75 per cent of the duties which formerly devolved upon the Secretary. That should be taken into consideration.

PRESIDENT: The Chair understands this Publication Committee to be a reference committee to which the Secretary can appeal. The Chair has therefore appointed members living in New York State, with whom the Secretary can confer on matters of fish culture and regarding the quality of papers submitted. The Secretary has still practically the same amount of work as before.

Motion put and resolution adopted.

PRESIDENT: The Secretary and the Publication Committee should have power in the matter of editing papers. Very often papers are sent in which have meat in them, but which are not in condition to send to the printer. They need blue-penciling and some times scientific correction.

A motion is in order to give the Recording Secretary and his advisory Publication Committee power to deal with papers submitted for publication by the Society.

MR. WILSON: As one who has enjoyed having his paper fixed up in a very nice manner, I would like to make such a motion.

PROF. WARD: I desire to second the motion, and, in so doing, would ask you whether it is meant that power should be given to prune or to reject entirely such papers as they see fit, having in mind the income of the Society and the possible size of the volume.

PRESIDENT: The Chair used the words "with power" in that sense. Regarding the 1912 Transactions, in the absence of the Secretary the Chair rejected entirely one paper that was submitted without signature and another that was merely a State list of fishes, but was manifestly incomplete and without annotations. Perhaps the Acting Recording Secretary and the Chair assumed too much authority, but that is what happened.

MR. BOWER: Authority should be given to cut down discussion.

PRESIDENT: The phrase "with power" includes that.

MR. LYDELL: They would have power to cut out entirely any papers submitted for publication?

PRESIDENT: That would be power to use their best judgment to make the publication of the Society as creditable as possible. The motion before the house is:

That the Recording Secretary and Publication Committee be given full power to deal with papers submitted for publication by the Society.

Adopted by the Society.

PRESIDENT: I am glad the Society has taken this action, because this work has thrown a weight of responsibility on the Recording Secretary which he was loth to accept. Hitherto he has had to use his own discretion or crowd in what was not always acceptable, as the Executive Committee were not generally accessible.

Will the Committee on Time and Place of Meeting please report.

TIME AND PLACE OF MEETING.

MR. WOODS, of Missouri: Mr. Chairman, the names of cities presented for the consideration of your committee were Chicago, Detroit, New Orleans and Indianapolis. The committee has unanimously selected New Orleans, and has decided upon September 30 and October 1, 2 and 3, 1914, as the proper time for holding the meeting.

Moved and carried that the report of the Committee be adopted.

MR. DAYRIES, of New Orleans: I wish to thank the Society most cordially for having selected New Orleans for the next meeting place, and to say that it will be our utmost endeavor to make your stay with us enjoyable and interesting.

PRESIDENT: We will now proceed to the election of officers for the coming year. The report of the Committee on Nominations will be presented.

REPORT OF COMMITTEE ON NOMINATIONS.

MR. CORLISS: If you will refer to the program, you will see that the principle of selection has been one of promotion. The Committee submit the following:

President: Henry B. Ward, Urbana, Ill.

Vice-President: Daniel B. Fearing, Newport, R. I.

Corresponding Secretary: George W. Field, Sharon, Mass.

Recording Secretary: Raymond C. Osburn, New York Aquarium, New York.

Treasurer: Charles W. Willard, Westerly, R. I.

VICE-PRESIDENTS OF DIVISIONS.

Fish Culture: Dwight Lydell, Comstock Park, Michigan.

Aquatic Biology and Physics: L. L. Dyche, Pratt, Kansas.

Commercial Fishing: Kenneth Fowler, 1 Fulton Fish Market, New York City.

Angling: H. Wheeler Perce, Chicago, Ill.

Protection and Legislation: T. S. Palmer, Washington, D. C.

EXECUTIVE COMMITTEE.

Jacob Reighard, Chairman, Ann Arbor, Michigan; George H. Graham, Springfield, Mass.; N. R. Buller, Harrisburg, Pa.; J. Quincy Ward, Frankfort, Ky.; George W. Miles, Indianapolis, Indiana; Ernest Schaeffle, San Francisco, California; J. A. Dayries, New Orleans, Louisiana.

COMMITTEE ON FOREIGN RELATIONS.

George Shiras, 3d, Washington, D. C.; E. E. Prince, Ottawa, Canada; H. M. Smith, Washington, D. C.;

Overton W. Price, Washington, D. C.; George W. Field, Sharon, Mass.

MR. BOWER: I move the adoption of this report and the election of the officers as stated. Seconded by Mr. Nesley.

Carried.

A rising vote of thanks was tendered the retiring officers of the Society and particularly to President Townsend and to Mr. Ward T. Bower who had served the Society most efficiently for several years as Recording Secretary.

PRESIDENT: I believe the report of the committee appointed to consider Dr. Smith's paper on the Fisheries Institute has not been received. Have they anything to report?

PROF. WARD: The suggestion has been made that this report should be read at dinner tomorrow, when there will be present some other gentlemen whose education in this line will be useful and may affect the report of the Committee.

It was moved and seconded that Dr. Smith's paper be re-read with the report of the Committee on the following day.

Approved.

Professor Henry B. Ward, the President-elect of the Society, was called upon to address the meeting.

PROF. WARD: Mr. President and members of the Society: I appreciate so greatly the responsibility as well as the honor which has been put upon me that I find it very difficult to say anything just at this moment regarding the matters which would interest the Society in any way. It seems to me clear, after having attended a series of meetings covering a number of years, that the Society has made a distinct advance in the last two or three years, and that this movement involves great responsibilities as well as great opportunities for furthering the interests which we represent. It will necessarily go back to the officers to determine in some measure at least the details of the plans which the Society shall inaugurate with those objects in view. I should wish to resign the office and run away at the present moment if it were not that you have wisely and thoughtfully associated with me gentlemen whose knowledge is so much broader than my own, whose experience is so much greater, and whose success in various fields is so clear that I feel some measure of confidence at our being able together to accomplish something within the year to come.

Two or three years ago, our Treasurer informed us that we faced a considerable deficit. The membership had not increased. The Society was not able to carry on even the normal round of activities which it had followed out for a number of years previous. At the present time the deficit has been practically wiped out, the membership has been tremendously increased, and, best of all, the interest and enthusiasm of the members has been multiplied many times. No one could ask for an opportunity to go into the Board of Officers in any more propitious time than the present. I am confident that it will be possible in various ways, within the near future, to exercise an even greater influence. The hard work in building up an organization, the difficult task of supporting it through a period of unfortunate decline or standstill, is always the beginning. After the membership commences to increase, after the condition of the Society has reached the point where it is normal, activities can be carried on without danger. The gentlemen who have presided in the past have provided these conditions for the officers for the coming year.

Perhaps nothing has appealed to me more strongly, in listening to the record of this year, than the paper by Dr. Smith—the idea advanced with reference to the education of the fisherfolk along fishery lines. I shall not speak further on this, because, in the discussion that followed, a Committee was appointed for that purpose. I merely call it to your attention, to impress it more forcibly, if possible, upon the minds of every member, that every member may be working to carry out the general idea suggested by Dr. Smith, and to advance the interests of the fisherfolk by providing such a nucleus.

I can only thank you for the kindness shown me, and ask you for your fullest and heartiest co-operation in the work of the coming year, that all the officers may be able with your assistance to advance the Society strongly on the road toward success on which it has already entered.

PRESIDENT: The chair desires to bring up another matter in regard to publication. Sometimes the papers presented at a meeting have been published by fishery journals in advance of their publication in our Transactions. Is this considered desirable by the Society?

MR. NESLEY, of New York: I believe it is desirable, because it will further instruction along the lines we are all interested in.

PROF. DYCHE, of Kansas: I do not know whether it is quite fair to restrict publication. For example there might be a journal or paper in my own locality in which I would like to publish an abstract. The proceedings of the Society may wait a year, and the usefulness of that article would be impaired if held up for that time. I would like to publish my papers in my own state, for I think they may do some good and my own people pay me for doing this work.

PRESIDENT: In some respects it would be desirable to publish parts of papers, but it seems to me that the paper as a whole should be referred to the Society; perhaps the majority of the paper might be published by permission of the author.

PROF. WARD: Should not the decision in regard to such papers be a proper part of the duties of the Publication Committee? It seems to me that in individual cases the decision must necessarily be different. I can hardly think that the Society would approve that all of every one of its papers should appear in a half dozen or more other publications before the Transactions were issued.

I move that the question as to the publication of papers otherwise than in the Society's Transactions be referred to the Committee on Publication who shall have the power to decide in the individual cases, after the consent of the author has been secured.

Motion carried.

The Society adjourned.

Thursday, September 11, 1913.

No formal meeting was held, but the members were entertained at a dinner at Nantasket, given by the Boston Fish Exchange. The paper by Dr. H. M. Smith was re-read and addresses were made by Professors Birge, Prince, Ward, Dr. G. W. Field and Col. Acklin, President of the Association of Fish and Game Supervisors.

In Memoriam

Honorary Member

DR. P. P. C. HOEK,

Scientific Fishery Adviser of the Dutch Government, Haarlem, Holland, Honorary Member since 1906. Died February 27, 1914.

Active Members

CHESTER K. GREEN

JOHN W. FREDRUM

H. D. GOODWIN

CHARLES JACKSON

PART II

PAPERS AND DISCUSSIONS

THE NEED FOR A NATIONAL INSTITUTION FOR THE TECHNICAL INSTRUCTION OF FISHERFOLK.

By Hugh M. Smith,
United States Commissioner of Fisheries.

(Read by Dr. Geo. W. Field.)

Herewith are presented some memoranda regarding the need of an institution, national in its scope, in which American fisherfolk may receive technical instruction in matters affecting not only their own material interests but also the welfare of the state and nation, through conservation of aquatic resources and improvement of methods of taking, handling, preserving, and utilizing water products.

One person in every 80 in the United States is directly dependent on the fishing industry, and yet in the entire country there is not a single university, college, academy or school where even the rudiments of an education in fishery technique may be obtained, either gratis or on the payment of tuition fees. Agricultural schools or opportunities for technical instruction in agriculture exist everywhere; but the fishing population is neglected by both state and federal governments, and private interest has not yet come to the aid of a most deserving and important part of our population. Education and instruction in the practical affairs of fishing and the dependent industries are quite as essential for the highest success and best results as in any other industry; and in some respects, growing out of changed economic and biologic conditions, technical instruction in this branch in the United States is of greater importance than in any other industry that deals directly with natural products.

This need of the fishing population for technical instruction in matters that are of vital consequence to them is recognized in various other countries (Ireland, France, Japan) where professional schools have been established under official, semi-official or private auspices. In Japan, especially, which has become the leading fishing nation of the world in respect to number of persons engaged, quantity and value of products taken, etc., the technical or professional instruction of the fisherfolk is regarded as an indispensable factor in the industrial prosperity.

The fishermen hold the balance of power in many states, and dictate legislation affecting water products. In various states the majority of the fishermen are of foreign birth, and owing to ignorance or prejudice are not always in sympathy with conservation and other measures that are for the benefit of the community and themselves. This condition of affairs has already resulted in enormous waste of aquatic resources and loss to communities, and in some fishing regions has reached a stage where the perpetuity of an important industry and the welfare of many people are threatened.

The fishing population, even when in the most enlightened communities, are proverbially difficult to reach and influence. Their prejudices are traditional, strong and deep-set, and it is only rarely that any remedial measures for their own benefit or for the betterment of the industry that supports them are originated or strongly backed by themselves. The state fishery officials are often looked on with suspicion owing to the fear, sometimes well-founded, that increased attention from the state means increased taxation.

No greater work in the cause of conservation of natural resources can be done than to bring to the notice of the fishermen of each community, by means of personal narration and demonstration, the life history of the creatures on which their livelihood depends and the treatment those creatures should receive at the hands of fishermen and legislators. In the case of the vanishing lobster, for instance, it could be guaranteed that a course of talks and demonstrations in 50 to 100 communities in New England would so educate the fishermen and produce such a change in sentiment and prejudice as to lead to immediate ameliorative measures in every state, resulting in the speedy restoration in abundance; whereas, at the present time, the fishermen, in their ignorance of even the elementary facts in the life of the lobster, are backing measures and practicing methods that are most destructive and foolhardy.

A tentative plan for an institution for the imparting of practical technical instruction to American fisherfolk may be outlined as follows:

I. OBJECTS:

a. Gratuitous instruction in fishery matters, adapted to local needs and conditions, and intended to render the fishing operations more effective and remunerative.

b. Practical conservation of the fishery resources of every region, resulting from an appreciation by the fishermen of the vital needs of the creatures sought.

c. The creation throughout the country of a corps of well-qualified persons who are able,

(1) To direct large industrial fishery operations and shore branches connected with the fisheries (as salting, canning, and smoking plants).

(2) To become technical experts in the administration of the fishery services of nation or state.

(3) To engage in or take charge of national or state fish-cultural work.

d. The gradual improvement of the morale of the fishing population, the placing of fishery work on a higher industrial plane, and the removal of purely economic fishery questions from local politics.

II. SCOPE AND METHODS:

a. Instruction of the fishing population (including women and girls) to cover the following subjects: Fishery methods and apparatus; preservation of water products for food, fertilizer, in arts, etc.; fishery legislation, protection and regulation; fishery administration; fish culture, adapted to government, state, and private operations, and applied to fish, shell-fish, frogs, etc.; aquatic biology and physics; utilization of waste products; conservation; navigation, etc.

b. Instruction to be by means of lectures, practical demonstrations, printed matter, and correspondence.

c. The affairs of the institution to be conducted from a central bureau and through the medium of special courses of instruction in numerous communities in charge of corps of experts, who may visit place after place in regular order.

d. The leading specialists in every branch of national, state, and private fishery work to constitute the nucleus of the faculty; and all existing facilities for study and practical work to be availed of.

DISCUSSION

President: This is a very important paper and I am in a position to state that when Dr. Smith made his visit to Japan he visited the very extensive fisheries institute of the Imperial Government of Japan, and it made a profound impression upon him. There is nowhere, in any other country, an institute of that kind. They teach almost all the branches connected with the fisheries, fish culture and marine biology, and it has frequently occurred to Dr. Smith that such instruction is needed in this country. We ought not to let the Japanese get ahead of us in this respect. Japan has been called the paramount fishing country, but the United States is one of the next, and it is to be hoped that we may see something like this in our own country.

Mr. John P. Woods, of Missouri: This suggestion has been presented in a very learned way in the paper we have just heard read and we should take special cognizance of it and act on it in whatever way may have the best effect. It is a very important matter and I move the appointment of a committee to consider it.

Approved.

President: I will appoint Messrs. Wood, Dyche and Prince, and will ask them to report at a later period of this meeting.

Mr. John W. Titcomb, of Vermont: Commissioner Smith has referred to a forward movement in agriculture. Something like a thousand elementary schools in agriculture have sprung up in the last ten years. In our State we have a movement which provides for associations of farmers and those associations are employing county agents, supposed to be experts, who go about among the farmers to learn of their conditions. It seems to me that this paper contemplates something similar in a fishing community, and if it does as much good as this movement among the farmers is doing it will help tremendously in forwarding the work of the fisheries and will be of great economic importance.

Fish culture has also been touched upon. I think Dr. Smith feels that we should have experiment stations. We have none today. We have fish culture stations, but not experiment stations, where we can try out theories, and I hope that will be included.

Dr. E. E. Prince, of Canada: I noticed a reference to Ireland in Dr. Smith's paper. I think Ireland preceded Japan in regard to education in fish matters. The Baroness Burdett-Coutts, forty years ago, provided the funds to found a fishing school for the purpose of instructing the Irish fishermen in the arts of fishing, use of bait, and, in brief, their fishing operations. The school was carried on by a priest, Father Davids, who arranged courses of instruction. When I visited the station, about twenty years ago, the fishing population were not thoroughly enthusiastic and the school was not so successful as it had been.

Another movement in Scotland, a little later, was started by the University of Edinburgh. Courses of instruction were given on fish life and on fish matters generally, and there again the Scottish fishermen did not take that intelligent interest in the work that was expected. I, myself, took part in a course of lectures upon fish matters, under what was called the Summer School of Science, and we hoped that the fishermen of the neighboring fishing towns were being benefited. I think when the fisherman left the lecture he felt that there was not very much to learn from the professors.

The point is how best to get at this work to make it successful. In the first place a little missionary work is necessary; and, in the second place, that work must be done by visiting fishermen themselves in the fishing towns. Fishermen, as a rule, are rather suspicious of instruction from scientific men, and in some respects perhaps they are right. The fishermen expect to learn all they can about catching fish. They do not find much instruction in that, but if their interest could be aroused in regard to conservation, there are many sources of waste which could be stopped at once, and the result would be to benefit the fisheries.

A very distinguished statesman in Britain once asked me to lecture in the North of England. I went to six or seven fishing towns and talked with the fishermen and found that my addresses were quite a success, but I did not quite understand the reason. It was explained to me that it was because I said in my first lecture that I wanted the fishermen to understand the fish, and I began by describing, amongst other things, the ears of the fish. The fishermen had no idea that the fish have ears. The Government stopped their guns being fired close by, for they said that if the fishes had ears, the big guns must be removed, which helped my cause. Of course, it was not my object, but the interest of the fishermen was aroused, and the first step must be to interest the fishermen.

A few weeks ago, at one of the biological stations in Canada, on the coast of New Brunswick, we visited some fishing towns in the course of scientific inspection, and in one little town of fishermen we were asked to arrange for addresses, a movement which came, I think, from the fisherfolk themselves. They suggested that while we stopped in this village we might put in some of our work in investigating deep-sea fisheries. We did so. It was good experience, and it was also a very great pleasure to find a crowded hall and the fishermen exceedingly interested in fish, young fish, eggs, etc.

So there is quite an opening for work of this kind, but if approached from the other side, the technical, college or university side, or by a course of lectures, you will not get out the people who really need to be instructed.

President: I do not think that people realize what a vast amount of inquiry respecting the fishes and fisheries has grown up in the United States Fish Commission. Those of you who have not been connected with the Commission do not know what a tremendous correspondence the United States Bureau of Fisheries has to handle. Everybody gets the best answer that the Bureau can give and the letters go all over the land to the American people, answering their inquiries; they include letters from common people, letters from fishermen who want to know the best way of selling; letters from those who want to know the latest results in regard to sardines; letters from those who want to know about salting fish; letters on all kinds of fishery work.

Now it has seemed to me that a great deal could be done if we could get together and teach men who would be willing to lecture to the fishermen. We cannot always get at them in the cities, and large cities are pretty well supplied with lectures of various kinds, but I am quite sure that somebody that knows about fish, lobsters or oysters, that could go to fishing centres where these are vital matters, would get a good audience, and such a man would be able to impart a great deal of useful information to the fishermen. Just how we should go about the founding of an institute of fisheries it is hard to say, but after our committee has talked this over we shall be very glad to hear their recommendations.

A PERFECT FISH PASS

Some suggestions as to Defects in Fish Passes and how to Overcome Them.

BY PROFESSOR EDWARD E. PRINCE, LL.D., D.Sc., *Ottawa, Canada, Dominion Commissioner of Fisheries and Representative of Canada on the International Fisheries Commission under the Fishery Treaty of 1908.*

Fishery authorities are practically agreed that the decline of salmon in most countries is due, more than to any other cause, to the blocking of rivers and lakes by dams, artificial barriers, etc. No one can doubt that overfishing, injury to spawning beds and fifty other unfavorable circumstances, have had small effect compared with the completely destructive character of dams and the like. Shad, alewives or gaspereaux, sea trout, striped bass, and other valuable fish, have also become practically extinct in many localities where they once abounded, all from the same cause.

FISH SECONDARY TO INDUSTRIES ON RIVERS.

Lumber mills, electric power houses, grist and granite work, pulp factories and other active enterprises, which more or less vitally depend upon water-power, have ruined some of the finest rivers in the world by entirely blocking them with dams and huge barriers. A lovely salmon river that was worth to the locality (in Nova Scotia) probably $50,000 per annum, was ruined a few years ago by the erection, not of one, but a series of dams in connection with the wood pulp industry and on a protest being raised, a prominent leader in the country replied, "$50,000 worth of fish must give way to $5,000,000 worth of industry."

INGENUITY AND NUMBER OF FISH PASSES.

No wonder that to overcome this grave trouble, ingenious and zealous minds, in almost every civilized country, have devoted time and great powers of mechanical genius, as well as vast practical experience of fish and fishing, to the subject of fish passes. Not only engineering and mechanical skill, but much scientific knowledge has been brought to bear on this fishway problem. There are probably three hundred kinds of fish passes in existence, differing endlessly in regard to details, but grouped as I have shown in a report published in 1902, under about 16 or 18 headings acording to the essential principle embodied in their design.*

PURPOSE OF FISH PASSES.

Now it will hardly be disputed that a Perfect Fish Pass should enable such a number of fish to ascend at their special time of migration, and to reach their accustomed breeding grounds, as to restore and permanently maintain their former abundance.

RESULTS DISAPPOINTING.

Salmon rivers on this continent, and in other countries, formerly produced every season vast numbers of fish, but it must be confessed that the building of fishways at great cost and the efforts of fish culturists have in no instance brought back the fish to their pristine plenitude. In the case of shad, alewives or gaspereaux, striped bass and other anadromous species they have not been restored, even to a moderate degree, in many rivers personally known to me. Indeed these fish are on the verge of extinction in spite of all the exertions of hatchery officers, of governments—state and federal—of fish and game clubs, and the true friends of fish generally. It is plain that no hatcheries can really benefit a river to the fullest extent if the fish are cut off from access to the upper waters. No salmon river can resume its pristine productiveness if one or more dams block all access to the best pools and spawning shallows.

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*Canada, Marine and Fisheries Report, "The Fish Way Problem," E. E. Prince, pp. LXXI-LXXVIII, 1902.

MOST FISH PASSES HAVE FAILED.

In common with my brethren in the national fishery services of the various countries in which we live, I have given much attention for many years to this subject, and what is the conclusion to which I have been compelled to come? I may state it by saying that a few days ago I remarked to one of the most eminent fishery authorities on this continent that "mill dams had done more harm than any other injurious cause," and I added "my reply to you if you put the question"—Is there a fish pass or fish ladder known to you which is a complete success in enabling large quantities of fish to ascend?"—my reply, I say, would be "I do not know of such a fish pass." And my distinguished friend, a man of very vast experience, said, "Well, Professor Prince, if you asked me do I know of a fish pass completely successful in enabling fish to ascend over obstructions such as mill dams, I would say, 'I do not know of such a fish pass.' My friend fully confirmed my own serious conclusions and I need hardly say that I speak from a very unusual experience, for I have examined numerous fish passes or fish ladders in various countries—in the British Islands, where immense sums of money have been expended by wealthy noblemen and other private owners of salmon rivers, in England, Scotland, Ireland and Wales; and no man knows better than I do the salmon rivers of North America, both on the Atlantic and Pacific coasts of Canada and the United States, and even where some success has been achieved as in the massive structures of masonry and concrete in Britain, the result is not equal to reasonable expectations. Rigorous tests made have shown that fish passes are, in general, a sad failure. One I know in Quebec Province cost $15,000 and never a single fish ever used it, and another not very far from Washington, D. C., costing $17,000, has never been proved to have enabled one fish to get up. On a Nova Scotia river, to give another Canadian example, a net was arranged at the upper entrance of a fish pass, which was arranged so as to capture any fish passing up the fishway, but the officer reported that no fish were actually taken in the net; one fish was believed to have got up and escaped from the net; but that was not very certain. A similar test was made not long ago by the Fisheries Bureau at Washington, with a similar result, no fish appeared to have found their way into the pass, nor ascended it and been taken in the net at the upper entrance. It is said that "One swallow does not make a summer," yet I am really prepared to admit that one fish would prove a successful fishway. One clearly proved case of a fish ascending and finding its way to the waters above the fish pass would, to my mind, silence criticism.

TWO MAIN FEATURES IN FISH PASSES.

What are really the difficulties? If we can decide what the defects of existing fish passes are, we can try to overcome them. No doctor can be expected to cure a disease unless he had made a diagnosis, and decided what the disease is. Most fish pass specialists have confined their chief attention to two points: (1) Strength and durability; (2) Reduction of the force or momentum of the water coming down through the fish pass. The first was important because ice and tremendous floods, and floating trees and logs, would injure or carry away a lightly built fish pass; and the second is likewise important because shad and alewives, and even salmon, cannot work their way up a cascade of water of very great momentum.

DEFECTS OF FISH PASSES ENUMERATED.

I think it will not be disputed that most fish passes have one or more, or perhaps all, of the defects I now mention:—

(1) Ice in winter damages or even destroys them.

(2) Floods in spring make them useless—tearing parts away and filling them with debris.

(3) At some seasons too much water, at other seasons too little or even none at all, make them ineffective.

(4) The entrance is usually too small to be found by the fish.

(5) The entrance is in an unsuitable place and may be ten, twenty or even fifty yards below.

(6) If covered, the fish pass is dark, and fish prefer to jump at a glittering waterfall rather than enter a dark box or suspicious closed trap.

A NEW FISH PASS DEVISED IN CANADA.

Now, gentlemen, I have been at work designing a fish-pass to overcome all these defects, and I had hoped to have a model and drawings here today. The main idea of this pass,—I shall call it "THE PERFECT FISH PASS," if it possesses all the advantages I claim for it,—has been in my mind for ten or twelve years, but only during the past summer have I actually erected one, a large model on a small stream in New Brunswick, where a natural fall or obstruction of nine or ten feet exists. My good friend and scientific colleague, Prof. A. P. Knight, joined me in this experiment and we succeeded with the idea excepting for two or three small details which troubled us for some time. We tried repeatedly to get over these small difficulties, but in vain. Hence my play of "Hamlet" today gentlemen, is the play with Hamlet absent. I decided, however, to bring the subject up even though I shall not have the satisfaction today of showing you the model and the drawings to scale. Prof. Knight has these, as he continued the observations of the model on the New Brunswick stream, after I left on a visit to Washington, and he wrote me since I left. "Its success," he says, "has been greater than I expected," and he adds in the same letter, that he has now no doubt "it will prove even more successful than you (that is, myself) had ever anticipated. In my humble judgment," he says, "this fishway will rank next in importance to the enforcement of adequate fishery regulations . . . . as a means of conserving fish-life."

Not only has the model over ten feet high worked well, but I had arranged for a far more conclusive test at

St. George's Falls on the Magaquadavic River, New Brunswick, this summer and fall. Some official delay arose and the pass could not be erected in time to enable salmon to use it.

TEST AUTHORIZED IN NEW BRUNSWICK, CANADA, AT ST. GEORGE.

The falls are 31 feet high, quite perpendicular, and at the head of a long, deep, narrow gorge or canyon, full of jagged rocks. Salmon every year get up the gorge and jump at the high falls, but none have ever, I fear, succeeded in getting up. I regard the place as one of the most difficult to be found, and selected it owing to my confidence that this perfect fish pass will succeed where every other fishway must fail. Had I been permitted to carry out my plan, I have no fear that it would not be a complete success; but it was possible only to prepare the materials this season and even if erected in September or October, salmon will not use it, for they ascend early and are seen jumping in July and August, or even in June. The Dominion Government has provided the money to cover the cost of this first Perfect Fish Pass, being apparently most anxious to at once adopt this pass. The case of this river will be even a more important success than on the rivers I have already referred to. The Magaquadavic River, though resorted to by salmon, year after year, is closed by the precipitous falls at St. George only a few hundred yards from its mouth. No salmon have ever got further up. Hence the success of this fish pass would create a new salmon river. A successful fish pass would not only restore rivers destroyed by artificial dams; but would open up waters hitherto inaccessible and therefore destitute of salmon owing to impassable falls. I shall test next year two remarkable rivers up which salmon ascend only a short distance. On one of these rivers (in Cape Breton) an obstructing fall exists not more than three or four miles from the sea, and the late Inspector Bertram informed me that he had seen 1,100 or 1,200 salmon in the pool just below the fall, not one of which could get up any further. I visited for the fourth time recently a famous salmon river in northern New Brunswick, up which the fish ascend for twenty miles, and then are blocked by lofty falls. The pools are few and the spawning grounds very limited, much of the twenty miles consisting of narrow rocky channels and gorges; but above the falls there extend for sixty miles the most perfect salmon waters, clear, transparent, rippling water, superb pools and riffles ideal in every way for spawning, and for the finest fly-fishing. Thus a river affording less than twenty miles would be converted into one of eighty miles and a far superior river by the erection of the Perfect Fish Pass at the upper falls.

THREE NEW FEATURES: A LEADER OR WING, A LARGE ENTRANCE AND PORTABILITY.

I do not wish to repeat myself, but as my Perfect Fish Pass may be found to be capable of meeting difficulties which I have overlooked, I trust that such difficulties will be mentioned here today. My object is to elicit a discussion and to hear of the experience of others, and I will close therefore by referring to a few of the features which will be found in this Perfect Fish Pass:

(1) To be of any use a fish pass must be found by the fish. The fish *must* find the entrance to the Perfect Fish Pass because a wall of wire netting, a "leader," is part of the design and stretches across the channel and guides the fish to the opening, just as salmon and other fish are led or guided into a fish trap.*

(2) The entrance is not small, dark or forbidding, but large and open and admitting all the light possible, hence no fish will be deterred from entering. The small entrance and narrow aperture in the successive compartments in most fishways are necessary to reduce the down-rush of water, to economize the water, and lessen

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*Most every existing fish pass is correctly named because the fish do pass it and fail to find it.

the momentum, but this is overcome in the Perfect Fish Pass.

(3) No ice or floods can damage it or interfere with it, and why? Because it is not there when the ice forms and when the freshets and floods pour down. Fish do not ascend streams after the ice forms, hence this new fish pass has been made portable. It is taken to pieces and removed for storage during the winter, as during that season it is of no use on the river. I asked a famous writer on fish passes how many months per year salmon, in his opinion, would use a fish pass, and he said "four months cover the main period," yet for four months actual use, fish passes are in position for twelve months, but the Perfect Fish Pass is so constructed and pieced together by strong brass bolts, etc., that it can easily be taken away in a few hours, and thus runs no risk of damage in winter or early spring. Salmon may ascend, for example, from June to November, but the most important run is during four months, say, July, August, September and October. The fish pass is in position and available then, and the few fish, before or after that period, can be neglected. These few fish must come up next year. "Too late, too late," the Perfect Fish Pass seems to say, "Ye cannot enter now, but you can come again next summer." The salmon supply for the future in any river is secure, I claim, if the main run are enabled to ascend during the period referred to.

One point before I close: It was my intention to place freely at the disposal of the Canadian Government this new device; but the official attitude assumed at headquarters questioning the granting of any authority to erect the first fishway on this new principle caused me to change my mind and in justice to Professor Knight, and in the interest of an engineer who aided me on some technical points I completed steps to protect it by patent. Such protection has been granted in Canada and has been applied for in the United States so that my fishway is not only as I hoped and claimed, entitled to be called "A Perfect Fish Pass," but it is what I had not originally intended or claimed, it is a Patent Fish Pass.

DISCUSSION

Mr. N. R. Buller, of Pennsylvania: The question of a fishway is one of the nightmares to the Commissioner of Fisheries of Pennsylvania and has caused us a great deal of thought and study in the past two years. The Susquehanna River has always been a shad river until two years ago, when the Carlbury dam, sixty-five feet high and three-quarters of a mile in length, was completed. There is a Kale fishway placed in the dam, but, on examination of the dam, carried on during the migratory season of the shad for three days a week, we failed to find one fish that had entered that fishway. After finding that the Kale fishway has not been satisfactory, the power company has started and nearly finished a fishway from plans furnished by the Department. That is a natural way, sixty feet wide, following down over the breast of the dam, widening out to a hundred feet where it catches the trend of the river, and is built of concrete and large boulders. This power company has met the Department of Fisheries more than half way at every request made of them, for I assume they want to put more dams in the river. We are very anxiously awaiting next spring to see whether this fishway will be adequate or not.

Mr. John W. Titcomb, of Vermont: I want to ask Prof. Prince about taking down and putting up the props. For instance, I want a fishway to take care of the spring spawning of the fish. In that case, on account of heavy freshets just at the time of assembling, the fishway would have to be installed in the fall, and if installed in the fall to carry it through the freshet period, it might as well be there the year through.

Prof. Prince: The fish pass is not put up until about to be used. Instead of being actually where the fall is, if necessary it could be put in a quieter place, 50 or 100 yards below, and a channel made so that when the fish have got up to the pass they will go along the channel over the dam.

Mr. Titcomb: That would have to be put in in the fall; you cannot do work of that sort in the spring with a freshet of two or three feet of water flowing over the dam. I am very sceptical about this matter, and I think if there are fishways supposed to be practical for commissioners, to expend quite a little money, if necessary, to find out whether they are doing anything or not. One year, the Connecticut River had a fishway put in costing $60,000 and not a fish went through it.

Prof. Dyche, of Kansas: In Kansas the Legislature passed a law four years ago, making it obligatory that dams be furnished with fishways and giving about six months to effect this. They called upon me to furnish plans. I got two or three good engineers to assist me, and finally, we got plans for a fishway which are published in the proceedings of this society. Then I built about a dozen or fifteen of these fishways.

To make the fish start through the fishway basin has been a failure. I wrote a public letter stating that I had been unable to build a fishway that was adequate, and that I didn't think it was fair to require owners of dams to build fishways when I could not guarantee them to be of value after they were built. The people living above these dams are sending in petitions and worrying about the fishways.

We have one fishway that the fish do go up. This was built by Wells, State Engineer, and myself, at Wichita, Kansas, where a dam was across a little river with three feet extra rise; when the water was high, it was let down; when low, it was lifted up.

We made this fishway of cement, to run up as far as the outlet. We dug down fifteen feet deep and brought the fishway around underground. The part that is underground is built of cement, but where it comes out it is of steel structure, which it is possible to remove during that part of the year when the fish are not in the stream. We found that catfish were going up right along. It was necessary to have a door made which could be locked to keep the fish from going up except when we had control, in order to keep poachers off.

Mr. A. H. Dinsmore, of Vermont: One of the most serious problems any one has is in connection with the salmon fisheries of the Pacific Coast. I want to ask Professor Prince if his plan is adaptable to the conditions there. Does he plan to put in a temporary wire barrier to stand when the fish are running? In the spawning of salmon on the Pacific Coast they always crowd at the flood periods.

Prof. Prince: I think it will work there. I claim that no fish pass erected for the flood period is good in low water. This pass would be erected before the flood season and would be adapted to those conditions. One of its chief points is that it can be taken down.

Mr. Seymour Bower, of Michigan: My experience in Michigan is very much the same. We have a law which requires the provision of fishways, but as far as I know they are an absolute failure. It seems to me that one remarkable feature of Professor Prince's fishway is the leader to guide the fish to the mouth, but I would like to know what material he uses, and how he is going to prevent the leaders from being carried away. In our state the question of testing fishways is going to be a very important one owing to the fact that rainbow trout are multiplying and eventually will be a very important commercial fish in the Great Lakes. In six streams that flow into Lake Michigan there were half a million to a million pounds of rainbow trout headed upstream toward the dams, and the number seems to be increasing rapidly, so the necessity for adequate fishways is of very great importance.

Prof. Prince: The full description of this fish pass, with drawings, is being printed, and I propose to send every one here a copy. The leader is one of the most important features. Its permanence is of no importance. It is made of chicken wire, and if carried away can easily be replaced.

Mr. W. C. Adams, of Massachusetts: The Indians in the West have shown us how to lead trout by building a rock wall two to three feet wide across the stream. The fish do not rise over this wall, but are led right to the fishway. We have one dam thirty feet high with a fishway consisting of a series of wooden boxes six feet long, four feet wide and four feet high. In this fishway I have seen twenty tons of trout waiting their turn to go over and running from box to box. We have taken out at this place as high as 5,000 spawn trout yielding twelve to fifteen million eggs. A wire leader would break down here with debris, for the fish go up only in the flood season; but with the rock wall under water, which the Indians showed us how to build, the debris passes over while the fish are led to the way. We have had such success with this method that we consider our problem solved.

President: The experience of Fish Commissioners is that the automatic fish pass is a failure. Perhaps the fish could be locked in dams like a canal pass, with very long locks which could be opened and closed as often as necessary.

SOME ANIMALS AND CONDITIONS INIMICAL TO FISH EGGS AND LARVAE IN THE SEA

By Professor Edward E. Prince, LL.D., D. Sc., Etc.,
Commissioner of Fisheries for Canada.

As one of the pioneers in the study of the eggs and young stages of marine food fishes, I remember an opinion expressed long ago by high authorities that the sea might be over-crowded with fish were there not some effective means in existence for checking their increase.

COD AND OTHER MARINE FISHES MOST PROLIFIC.

At that time the number of species of marine and fresh water fishes, exclusive of sharks, etc., known to science, was about 12,000, and as I stated in a paper on fish eggs published in 1886, the eggs of not more than 80 species had been discovered and described.* At the present time over 100,000 species of Teleosteans are known to Ichthyologists and the eggs and something of their larval development are known of about 350 species. As long ago as 1864, G. O. Sars in Norway had shown that cod, mackerel, haddock and, I think, gurnard (*Trigla*) eggs, floated near the surface of the sea, and J. A. Ryder and others in this country, McIntosh in Scotland, G. Brook, J. T. Cunningham and others in England, proved the same thing of these and a number of other species, and pointed out that the eggs were produced not by thousands, as in the case of salmon, trout and herring, but by millions. Their eggs were stated to be not large and heavy and deposited on the bottom of the water; but quite minute, almost microscopic in size (30 or more in a row extending barely over a linear inch) and so transparent as to be nearly invisible, while their small specific gravity caused them to float near the surface of the sea. The number of eggs produced annually by most of the important marketable fish to which I

*On the Presence of Oleaginous Spheres in the Yolk of Teleostean Ova. Annals of Natural History, London, 1886.

have referred, is so vast as to be almost beyond human comprehension.

PARENT FISH MASSED ON SPAWNING GROUNDS.

The young fish hatched out in localities, known as sea-fish nurseries, resemble in their myriads the clouds of mosquitoes in a vast marsh. This is easy to understand when it is remembered that in such areas as the Canadian fishing grounds on the Labrador Coast, and on the banks of Newfoundland, the spawning cod assemble in such crowded schools that even steam vessels find themselves impeded when moving through them, and one of our Dominion officers referred to this a few years ago, almost repeating the words of Jacques Cartier, three centuries before, who found it no unusual thing to have the wheels, or rather keels of progress in the sea, blocked by these schools of breeding fish, crowding the surface waters where they were schooling; and Dr. Wakeham, one of the most experienced of Canadian Fishery Inspectors, has referred to this same feature, viz: the difficulty at times of navigating through the massed myriads of cod when schooling.

FLOATING FISH EGGS EASILY KILLED.

I found in my early studies and experiments that floating fish eggs in the sea are very sensitive to unfavorable influences. On the other hand they seem to be indifferent to many influences that might be thought equally detrimental. A fisherman putting his hand smeared with paraffin oil into a tank of cod eggs caused the death of many thousands, as a film of oil spread over the water and seemed to coat each minute egg and suffocate it.

I once lost some valuable jars of hatching mackerel eggs by a shower of soot from the funnel of a Government Survey steamer descending at a most inopportune moment. That was in 1892, in Ireland, when I was the first, I believe, to hatch out larval mackerel, and I had completed some drawings and descriptions but wanted the stages a little older. My work was spoiled, for the soot persisted in clinging to the floating eggs, and Mr. J. T. Cunningham and others published results which they made later than my hatching experiments and thus had priority.

Chemical and physical changes in the surrounding water affect fish eggs harmfully. Many of you have read Dr. Knut Dahl's interesting paper on the problem of sea fish hatching (Conseil Intern, pour l'Exploration de la Mer. Rapports et Proc. Verb. Volume X, April, 1909). Hansen had found long ago vast numbers of dead pelagic eggs on the bottom of the sea and Dahl no doubt found the reason for this, at any rate in the condition in certain Norwegian fjords where he says deep layers of water remain unchanged and stagnant, saturated with sulphuretted hydrogen and devoid of oxygen and showing the absence of higher animal forms.

FLOATING EGGS SINK AND MAY DIE.

The varying specific gravity of the water also affects pelagic eggs in a remarkable degree, and in March, 1905, Dahl says that at 2 meters (78 inches or over 2 yards depth) he got 12 eggs at one Station, 26 eggs at 5 meters, 610 eggs at 10 meters, and 1190 eggs at 30 meters; possibly owing to fresh water at the surface, the cod fry at the same depths were respectively 1, 4, 62 and 76. In the southern waters of the Norwegian coast cod eggs and larva will float in still water of an absolute specific gravity of 1,021, but if below that they sink down lower and lower.

Again, winds, currents and tides affect the floating eggs so that vast numbers not only drift far from their original localities, but may even be washed ashore and destroyed. It is on record that flat beaches have been noticed glistening with untold millions of these minute glassy globes, the eggs of cod, haddock, etc., just as Professor McIntosh found in Scotland a long beach strewn with the delicate needle-like *Sagitta* after particular storms and winds.

FLOATING FISH EGGS SURVIVE SOME PECULIAR CONDITIONS.

But curiously enough these delicate eggs will resist some most unfavorable environments. I have seen a stone jar with cheese cloth over the top, filled with cod eggs floating in sea water and arriving after a long journey of several hundred miles in fine living condition, though a strong putrid odor was perceptible and the water was foul with decayed animal matters.

I have kept floating eggs in watch glasses or shallow glass dishes, and they lived and hatched out, and the young larval fish survived for some days, though the water was becoming more saline daily through evaporation. Professor McIntosh, long ago, told of an experiment with floating eggs in a test-tube which he heated until the contents were almost boiling, and he laid the tube aside only to find accidentally, a few days later, that the young larval fish were actually swimming about.

PELAGIC FISH LARVAE AND CRUSTACEA DEVOUR EACH OTHER.

There is no doubt that fish eggs form a part of the food of many vertebrates and invertebrates in the sea.

The older fish often gorge themselves with eggs and fry; but as Professor Fabre Domergue of the Concarneau Laboratory has said, in his beautiful monograph (Development de la Sole, Paris, 1905), the young fish, after the yolk has grown, become most active hunters after other fish and attack even larger larvae than themselves. At first the victim may escape, but after many repeated attacks, they rarely miss their prey. The victim, as bulky and as long as the hunter, cannot be swallowed at a single gulp, but one sees the tail wagging actively as it protrudes from the mouth, and so transparent are the fish that the victim can be seen passing into the gullet and then into the stomach. "Total deglutition," says Fabre Domergue, "may last more than an hour, and one may constantly have passing under one's eyes, undeniable proof of their appetite for the tail of the victim protudes more or less from the jaws. It can be best described as giving the impression that the young fish seems to be smoking a pipe. Little by little the prey is swallowed and disappears."

I have seen young fish, one -fifth of an inch long, swallowing Copepods more than half their own length, and the antennae and swimming feet could be observed protruding for some time from the mouth of the devourer, On the principle of *lex talionis*, the Copepods make war upon the larval fishes, though probably only upon those that are weak and in a moribund condition. It is true that I noticed a bright green Copepod in Irish waters over 20 years ago that seemed to attack floating eggs; but I had not the time or opportunity to ascertain to what extent this might be the case. On numerous occasions, however, I have found *Temora, Calanus, Oithona* and other species of Copepods, abundant in New Brunswick waters, making short work of dead larvae of various fishes. So rapidly do these minute crustaceans do their destructive work that unless minute organisms, removed from the townet, are placed in preservatives, only small fragments will remain, especially of young fishes. I have not actually seen Copepods attack living fish-larvae of the minute types occuring in the surface waters of the sea.

MEDUSAE AND OTHER JELLYFISH KILL FISH LARVAE, ETC.

There is, however, clear evidence of the destruction worked by certain jellyfish. Professor McIntosh, of St. Andrews, Scotland, long ago described and figured a Ctenophore, *Pleurobrachia,* swimming downwards in the sea and engulfing a larval crab (in the zoea stage) and later in his book, jointly issued by Dr. Masterman and himself, he gave a figure of a Ctenophore which had captured a larval fish, whose head protuded from the mouth or manubrial aperture, though the body and tail were partly digested.

In 1888 Professor McIntosh described a small medusa (*Thaumantias*) as most predaceous and so "greedy that it engulfs post-larval fishes and thus it is necessary to remove them from contact with the Cydippes at the moment the floating townet is brought on board," while in his "Resources of the Sea" he specially mentions "the tax levied by jellyfish and Coelenterates generally upon animals in the sea as high in the scale as fishes." Dr. V. Hensen in 1883 claimed that "the small *Sarsia tubulosa* measuring only 1½ centimeters eats fish eggs. I had placed a small number of eggs with broken yolks measuring on an average 1. 2 mm. in a glass vessel into which a specimen of *Sarsia* had accidentally found its way. Several were missing later and the gastric chamber of the *Sarsia* was swelled out considerably." The peculiar creeping jellyfish, the ambulatory gonozoid of *Clavatella prolifera* discovered at Torquay, England, by the eminent zoologist, Rev. Thomas Hincks, is described by him as an agile climber at one time using its suctorial discs as feet, and moving with ease up the perpendicular sides of a glass vessel, at another employing them as hands, and climbing amongst the branches of seaweeds. DeQuatrefages described an allied creeping medusa *Eleutheria* which drags itself with difficulty over a smooth surface; but displays considerable activity as soon as it reaches a tuft of sea weed. *Eleutheria* keeps the mouth turned upward when it moves. *Clavatella* on the contrary always carries it below.

Now, it is well known that young fish live commensally as boaders, so to speak, with some jellyfish. Many observers have noticed this. Dr. Knut Dahl, indeed, tells us that he saw in the Skagerrack, the pelagic young of cod, haddock and whiting in great masses, drift past under jellyfish at a speed of 3 to 4 knots. The sea was quite full of jellyfish and under nearly every one of them swam one or several young fish. All the jellyfish or medusae are not so hospitable, and I have made a special study of some cases of destruction of young fish by small medusæ. If, as I have reason to think, vast numbers of these creatures devour fish as part of their food the loss of young fish must be very extensive.

IMMENSE ABUNDANCE OF JELLYFISH.

A few weeks ago I passed in a small scientific launch through countless masses of jellyfish (chiefly *Aurelia*) in Passamaquoddy Bay. The numbers of various species are often almost beyond belief, and in the State of Connecticut, some years ago it was stated that shad fishing was stopped by the jellyfish whose hordes literally swept away the nets and stakes like an onrushing army.

Dr. Richard Rathbun in his report on Pacific Fishing Banks (United States Fisheries Bureau Report, Part XVII, 1893) says of Slime Bank in Bering Sea: "This bank derives its name from the occurrence of immense numbers of a large jellyfish, brownish or rusty in color, and provided with long slender tentacles, having great stinging powers. These jellyfishes, it is said, have never been observed at the surface, but seem to occupy an intermediate zone toward the bottom, where they occasion much annoyance to the fishermen by becoming entangled about their fishing gear, and in this way are often brought on board the vessels. It is also reported that sometimes they even interfere with the hooks reaching bottom, and, by covering the bait and lines with a prickly slime, render the former unattractive to the fish and the latter very uncomfortable to handle. In the early part of the season not much trouble is experienced from this cause, but by July 1, the jellyfishes become so thick that it is almost useless to remain longer upon the bank, and other localities farther north are then resorted to. Except for this unusual phenomenon, however, the advantages for fishing on Slime Bank are excellent. The largest and most thrifty looking cod were taken by the *Albatross* some 6 or 8 miles from shore, but fish of fair size and good quality were plentiful over nearly the entire bank. Small specimens of halibut were also secured occasionally, and the beam trawl disclosed a rich bottom fauna. Attempts have been made to use cod trawls upon this bank, but without success, owing to the obstacles which the jellyfishes interpose."

HOW MEDUSAE KILL FISH.

It is remarkable how few cases have been observed of the actual seizure and digestion of small fishes by medusae. This lack of observations, in view of the vast abundance of jellyfishes in most seas where small fishes abound, is astonishing, and adds, I think, to the interest of the study which I shall briefly set forth. At Canso a few years ago I captured a young *Obelia* less than a half-inch in diameter which had captured a small fish more than half an inch long. *Obelia* has no long tentacles for seizing prey and its hanging manubrium, with mobile mouth opening, is not specially well-adapted to grasping active living creatures such as fishes. Yet I found that this specimen had not only caught a small fish, but that it was nearly masticated and digested, and only the head and the bright metallic eyes were recognizable, barely protruding from the mouth. Apart from the squeezing action of the manubrium the pulsations of the medusa enlarged and diminished the capacity of the radial gastro-vascular canals, the pumping, or rather, suction action aiding in breaking down and tearing off fragments of the body of the larval fish which had been ingested tail first. Now it is well known that the oral and gastric endoderm cells copiously pour out a secretion which has the action of a ferment or solvent upon food materials. A process of digestion commences as soon as an object like a small fish passes into the manubrial aperture. The food is broken down by mechanical pressure and squeezing, and is mingled with the ferment and sucked inwards. Particles of the fish could be seen passing into the fundus of the gastric cavity whence four radial canals pass off to join the circular marginal canal. The endoderm of these canals is ciliated, though sparsely, causing a circulation of the watery gastro-vascular fluid in which float the macerated food particles and the dissolved liquid elements. Intra-cellular digestion, as Metchnikoff and Ray Lankester found, takes place over limited areas of the internal walls, but the nutrient matters are probably not transferred to the deeper tissues osmotically, to any large extent. Most of the dissolved food, digested intra-cellularly, appears to be returned to the alimentary system and carried by the gastro-vascular canals to remoter parts.

I cannot, however, go into details as to the anatomy and physiology and the minute histology of this interesting phenomenon of the digestion of small Teleosteans as observed by me in the jellyfish. I am publishing elsewhere an elaborate paper on that subject. All that is necessary here is to state that the destruction of young fish in the sea by medusae has been demonstrated, that the fish seem to be seized tail first by the prehensile manubrium, masticated in the gastric chamber and dissolved by gastric solvents while the pulsations of the bell-like or umbrella-shaped medusa, driving it through the water, produce a squeezing and sucking effect most effectively macerating even a large object like a fish half an inch long. The circulation due to cilia in the gastro-vascular canals, the digestive ferments, and intra-cellular digestion, complete the nutritive process, whose finely ground and digested elements are carried to the most distant parts of the bell-like body.

Truly the enemies of young fish are legion in the surface waters of the sea, but Nature has made ample compensation by rendering our most valuable food fishes the most wondrously prolific of all vertebrates.

DISCUSSION.

President: This is a world of tooth and fang and sharp claw, where things eat and get eaten. Professor Prince has presented this subject in a striking way and it will suggest to us all that the importance of these lower organisms in fish life may be much greater than we have hitherto supposed. Enormous numbers of fish eggs do certainly disappear somewhere, for some of these fishes produce them by the million. In a few cases, I have been able to observe their seizure by small organisms, but the evidence is difficult to obtain, and proofs of such seizure are rare.

Dr. Huntsman, of Ontario: A year ago I started to study wall-eyed pike, keeping them in quantity, and they began to eat one another. In all cases the captured fish was taken tail first and the captor swam about with the head of his prey protruding. One fish was captured at our biological station with three heads protruding from its mouth. With the perch, too, it was found that specimens from four to six inches long had often swallowed others of the same species and in all cases these were taken tail first. Notice this reversal of the usual method.

Professor Ward: In connection with this question it seems rather odd that such a slow creature as the jellyfish should be able to capture a fish by approaching it from behind. I should think it doubtful that it could do so under ordinary conditions, though it might if the fish were weakened. Professor Prince has alluded to the fact that fishes have been seen sheltered by jelly-fishes. Here on the northern coast the jellyfish (*Aurelia*) seem almost constantly to have young haddock associated with them. I think these fishes were truly sheltered and in no danger of being eaten. Jellyfishes also furnish food for fishes.

POSSIBILITIES OF AN ACRE FISH POND

By Prof. L. L. Dyche, *State Fish and Game Warden, Pratt, Kansas.*

Three years ago an acre pond at the Kansas State Fish Hatchery was stocked with several kinds of fish. The exact size of this pond, which was No. 4 in the old series, was one and sixteen one-hundredths (1.16) of an acre when the pond was at standard height, but as the water usually stood a little below standard, the pond was almost an exact acre in size. After the pond was stocked, but little attention or care was given to it for a period of three years. The pond was stocked as an experiment and with the hope of raising some good brood stock fish that could be used in the future to stock a proposed new fish hatchery. The pond is nearly circular; however, shape makes but little difference. At the edge of the pond the water is shallow, but the ground or bottom surface in a general way is basin shaped and gradually slopes to the deepest place, which is about thirty feet from the east shore line. At the bottom of this deepest place or kettle there is a drain pipe which is used when it is desirable or necessary to lower the water or drain the pond. When the pond is full of water or at standard height, it is six feet deep in the deepest place. This pond has a soft mud bottom, except for a few spots where the ground is rather hard and covered with a little sand and gravel. The water is carried into the pond through two three-inch pipes that connect with other ponds. However, just enough water was allowed to run into the pond to keep it at a certain height. Usually, the water stood about five feet deep in the kettle in the summer time and six feet in the winter time, the idea being to keep the pond supplied with water, but not to have any overflow or waste. There are many ponds in the country that are fed from wind mill pumps, or from springs or small streams. Under such conditions there is little or no water to spare. When there is an extra supply it is usually needed, either for stock or for small garden irrigation, or for both purposes.

VEGETATION IN AND AROUND THE PONDS.

This acre pond had in previous years been thoroughly stocked with water plants, including various kinds of so-called "mosses," especially *Chara* and one kind of lily (*Castalia odorata*). There are several patches of these lilies and we estimated that about one-fifteenth of the surface of the lake was covered with lily pads. The north and east banks above the water line are covered with swamp grass, with a few rushes along the water line. Higher upon the bank small willows are growing and some of them hang over the water. A number of large cottonwood trees stand on the south and west shores of the pond. They furnish some shade, but we do not consider them of any particular value in connection with fish production. There are other ponds that do quite as well and even better, that have no trees around them. We do not advise having trees right up against a pond. A grove of trees should be a little distance from a pond so as to reduce the number of leaves that would fall and blow into the water. The leaves are of no value to the fish and frequently color the water and in some instances have been known to damage the water, when the pond was low, to the extent that it rendered it unfit for fish to live in.

STOCKING THE POND.

Three years ago in the spring of 1910, this pond was stocked with about 10,000 yearling fish, most of which had been raised in it. All of the larger fish were removed, together with 20,000 yearlings. The fish that were allowed to remain were black bass, crappie, blue-gill sunfish, common green sunfish, bull-head catfish, a few hickory shad and German carp and about 300 goldfish. Many of them were small and only fit for food for the larger bass. In the fall of 1910, a few months after the above stocking, about a thousand more small fish of various kinds were added to this stock, including 200 black bass that were from four to six inches long. These bass had been hatched in the spring and were unusually large and fine for their age. They were cannibals and we placed them in this pond because we had no other convenient place for them. We usually distribute such fish as soon as possible after getting hold of them, in the larger creeks and rivers.

In the spring of 1911 about 1500 two-year-old crappie were added to the stock of this pond. These were a fine lot of fish and many of them had spawn in them. However, they were the same size and age as the yearling crappie that had been left in the pond in 1910. At this time 2,000 bullhead catfish, one and two years of age were added to the stock; also 192 channel catfish that would weigh from one to two pounds each. The channel catfish were placed in the pond by mistake, due to a misunderstanding of orders. About one-half of them were caught at the feeding station and removed during the summer and fall of 1912.* During the spring of 1912 about a thousand more one and two-year-old fish, a miscellaneous lot, were placed in this pond. They were mostly small fish that we had no particular place or use for. They were thrown into Pond No. 4, as it was called, with the idea that they might, for the most part, serve as food for the other fish. Altogether about 16,000 fish were placed in the pond; however, many of them were only considered as food fish for the others.

FOOD FOR THE FISH PRODUCED IN THE POND.

Around the shores of this pond during the spring and summer of the year 1912 and 1913 there were thousands and thousands of young fish to be seen, frequently appearing in clouds or bunches several feet long. Among these young fish we noticed bass, blue gills, sunfish, carp, goldfish, shad and bullheads. It was very apparent that many of the fish in the pond had spawned and that great numbers of the eggs had hatched. This crop of

*They did not breed in the pond, at least no young fish were found. We considered it a misfortune to have them in with the other fish which they continually fed upon.

young fish served for the most part as food for the older and larger fishes.

This pond, from the time it was first stocked, was allowed to stand practically undisturbed. Most of the food supply for the fish was produced in the pond. The dense growth of vegetation was not disturbed except that boats were sometimes run through it to open up channels of water. The chara "moss," lilies and other water plants grew to the extent that the surface of the water during part of the summer months was almost a solid mass of vegetable matter. This growth of vegetation so completly covered the surface of the pond that at times only small patches or lanes of water could be seen. On two or three occasions during the hottest part of the summer, the water went down until the deepest basin was not over four or four and one-half feet in depth. This was due to growths of vegetable matter that partly stopped up the water pipes. The pipes were opened as soon as it was discovered that the water was going down in the pond.

TEMPERATURE OF WATER.

The temperature of the surface water during the month of August, taken at 8 A. M. and 5 P. M., varied from 70 to 91 degrees Fahrenheit, the usual temperature varying somewhere between 80 and 86. The temperature taken at the bottom of the pond was from one to three degrees lower than at the surface, but never as much as four degrees. The temperature of the air for the same month taken in the shade at 8 A. M. and 5 P. M. ranged from 70 to 95 degrees Fahr., but on a few occasions was over a hundred at some intervening time during the day.

HOW THE FISH WERE FED.

The fish in this pond, when fed, were given liver, chopped up fish, corn chop and some small quantities of other kinds of food. They were fed from a platform that was built about fourteen feet from the east shore and near the deepest basin in the pond. A boardwalk led from this platform to the shore. On the platform there was a chopping block and during the summer of 1911 and 1912 about five hundred pounds of liver and five or six hundred pounds of fish, mostly German carp, were chopped up and fed to the fishes. When the chopping began, the fish would appear, the bass first and then the channel catfish. The bass would take the first food that was thrown on the water. It was necessary to satisfy them before any of the other fish would have a chance to get any food. The channel catfish would feed next. The blue-gills and green sunfish would feed around the edge of the general mass of fish, grabbing and darting away with anything they could get. The bullheads would come last and stay longest and would take food from the surface of the water. No crappie were ever seen to come near the feeding station. If they fed at all it was so deep under the water they could not be seen. About 200 pounds of corn chop were thrown in on the feeding grounds and perhaps as much as fifty pounds of kaffir corn. The catfish, carp and goldfish took most of this. However, the blue-gills and sunfish took some of it. When bread was thrown in the goldfish, carp, bullheads and blue-gills would take it.

REMOVING THE FISH FROM THE POND.

About the middle of April, 1913, we began lowering the water in this pond. From April 25, to April 30, the fish were removed and placed in other ponds. Most of the fish were used to stock the ponds of the new hatchery. After the water had been lowered the large fish were rounded up by the use of seines with meshes an inch square. Minnow seines were used to capture the small fish. The fish were removed from the water to the tubs and transfer tanks by the use of hand nets ranging in size from eight to twenty inches in diameter. A stream of fresh water was allowed to run through the pond until all the fish were removed. This prevented the water from getting so muddy that it would injure the fish.

FISH TAKEN FROM THE ACRE POND FROM APRIL 26 TO APRIL 30.

No. spec.	*Kind and size of fish*	*Lbs. each*	*Total lbs.*
280	black bass	large 2½	700.
310	black bass (1 and 2 years)	1	310.
95	channel catfish	large 4	380.
1,986	bullheads	" 1	1,986.
630	bullheads, yearlings & 2 yr. olds	" 8 to 1 lb.	79.
350	crappie, dark (calico bass)	" 1¾	612.50
500	crappie, one and two yrs.	not est.	
1,490	blue-gills	large ½	745.
1,100	blue-gills, two yrs.	" 6 to 1 lb.	183.
650	goldfish	" 1½	975.
	goldfish, young, very few		
27	carp	" 6	162.
	carp, young, very few		
103	hickory shad	" 1½	154.50
227	hickory shad (2 and 3 yrs.)	" ½	123.
700	green sunfish	" 3 to 1 lb.	233.
1,000	green sunfish	" 6 to 1 lb.	166.
5,000	green sunfish (1 and 2 yrs.)	not est.	
12,000	bass, crappie and blue gills, yearlings	not est.	
26,448	Total number of fish taken out of pond.		
	Total number of lbs. of fish taken out of pond		6,809.00

The above list is about as nearly correct as it could be made under the circumstances. We could not weigh all the fish, but fish of a certain size and length could be measured and weighed. There were two large-mouth black bass that were over twenty-two inches in length and each weighed a fraction over six pounds. They were females and heavy with spawn. There were many crappie that would weigh over two pounds, and bull-heads that weighed over two pounds. The carp would weigh from five to twelve pounds. There were many channel catfish that weighed from four to eight pounds.

There were 1,986 large bullheads but only a very few yearlings and two-year-olds, 630 all told. There were only 350 large crappie, though 1,500 fine two-year-old specimens were put in the pond in the spring of 1911. They were undoubtedly devoured by the larger bass and channel catfish. Only a few one and two-year-old specimens were found. There were 1,490 large blue-gills and only a few young fish; 650 large goldfish and almost no young; 27 large carp and less than 100 young fish. There were more young of the green sunfish and blue-gills than of any other variety.

While the channel catfish were being handled in the transfer tanks, they would spit up fish that they had swallowed. Sunfish, blue-gills, crappie, goldfish and gizzard shad were most common among the ejected fish. They would range in size from one ounce to one-half pound each. The bull-heads spit up the same varieties of fish but, of course, the average size of specimens was smaller.

About 16,000 young fish were placed in the ponds (as counted). About 27,000 of all ages and sizes were taken out. Estimated weight of fish placed in pond not to exceed 700 lbs. Estimated weight of fish removed from pond was 6,809 pounds.

The total number of fish that weighed one pound each or over, was 3,801, and their total weight 5,280 lbs.

Black bass, crappie and catfish made up 3,988 pounds of this weight. If the weight of the blue-gills and green sunfish that were large enough to eat were added to the above, it would amount in all to over 5,000 (5,315) pounds of good table fish.

The carp, goldfish and gizzard shad weighed over 1,400 pounds.

The amount of food fed to the fish while they were in the pond can be summed up as follows:

500 lbs. chopped up liver and meat.
600 lbs. chopped up fish (mostly German carp).
200 lbs. corn chop.
50 lbs. Kaffir corn.
50 lbs. other kinds of food (bread, oatmeal, potatoes, etc.)

It might be well to note that about five bushels of tadpoles of the bullfrog were thrown into this pond after it had been stocked. Crayfish were common in this and adjacent ponds.

DISCUSSION

President: I hope that the Society is properly impressed with this paper. It is an amazing record. I have never heard anything like it and I strongly suspect that Prof. Dyche has put most of us to a standstill in the matter of pond fish culture. Prof. Dyche's experiments show that there is an enormous increment and that the fish food supply can be greatly increased by pond culture.

Mr. Bower, of Michigan: I agree with the President that this surpasses any record of which I have any knowledge. We are carrying on similar experiments, but have never begun to equal it. I think it is due very largely to the high temperature of the water and the production of an immense amount of natural food. In our latitude we could hardly have the same conditions and our ponds, if they ever get as warm would not remain so for many days in the year. It shows what might be done and that we might very profitably engage in such culture, but whether it could be made more profitable than land culture I do not know.

Mr. Lydell, of Wisconsin: We have a pond similar to the one Prof. Dyche has described, and for the last two years we have been dumping into it almost everything with the idea of rearing our own stock fish instead of collecting them in other waters. So far we have been very successful, but nothing to compare with Prof. Dyche's experiment. This pond is about 72 degrees, at the warmest, so that we could not get the same growth in the same length of time as he would get in a warmer pond. We are hoping to build a larger pond with a view of raising our breeding stock instead of collecting it.

Dr. Geo. W. Field, of Massachusetts: May I call particular attention to the fact that this is one of the best and one of the first instances, perhaps, of definite information as to the quantity of fish that can be raised in a given amount of water. Also there is the question of handling this pond on the principle of the aquarium, with the specific data of how much food a certain quantity of fish require. The application of this is very important. As the country becomes more settled, it is absolutely necessary to furnish the people with pure drinking water. If, on the one hand, carnivorous fish are allowed to grow in reservations of drinking water, judging from observations we have made, you will get a small number of large fish, and the algae which cause the poisonous odors and taste in drinking water will multiply unduly. On the other hand, if the right proportion of carp fish are kept you will have the best conditions to secure the best quality of water. We need specific data on ponds, and Prof. Dyche's work will help very much toward the solution of the problem.

Mr. Titcomb, of Vermont: In our part of the country it would be impossible to do anything of this sort. The colder the water, the less the number of fish. A great many deductions can be drawn from these data and I want to inquire of Prof. Dyche whether, if he were to conduct the experiment again, he would put in as many fish as he did in this case? I believe he acknowledges he would not put the catfish in.

Prof. Dyche: I am in doubt. I would not leave out the hickory shad or the goldfish, for I prefer these for food fish. I am not sure about the carp, they grow pretty large, and the young carp grow faster than the goldfish. I would leave out the carp and the channel catfish, but nothing else. I do not say that you would have to have goldfish and hickory shad, but there should be fish enough of some kind to consume a large amount of waste and convert it into food for the young bass, blue-gills and crappies. The blue-gill is one of the best fish we have for food for the bass. We are raising tens of thousands of blue-gills and goldfish. The blue-gill spawns about a month later than the bass and on examining young bass in the fall we find they have been feeding on the blue-gills. If they do not have these or some other fish to feed on they will eat each other.

Mr. Titcomb: You have considerable algae?

Prof. Dyche: Yes. At certain times in the spring the spirogyra is abundant. The goldfish feed on it. Duckweed comes in immense quantities, and the goldfish feed extensively upon it. We have 20,000 yearling goldfish in one pond now and it takes 20 to 30 pounds of duckweed per day to feed them. The goldfish are to serve as food for spawning bass this winter. The more vegetation we have in the ponds, the more fish we get, other things being equal.

MR. TITCOMB: Does that restrict cannibalism, and do the fish get full size?

PROF. DYCHE: Yes and no. On the vegetation, in the warm water, at 84 to 88 degrees all summer long, are snails and other forms of animal life of various kinds. The little fish feed in this vegetation. The bass grow large and fine. We got fish out of the acre pond to stock nearly the whole series of ponds. This pond was a very great surprise to me and the men working on the hatchery, as well as to everyone else, because we got two or three times as many fish as we expected to get and we were expecting a good crop.

MR. TITCOMB: What was the average depth?

PROF. DYCHE: I cannot say. It is six feet in the deepest place in winter and five and a half in summer. Around the shore it is about fifteen inches deep and slopes down gradually.

MR. TITCOMB: Would you expect the individual who owned a fish tank to stock it in any such way? Would you recommend the same varieties?

PROF. DYCHE: I do not see why a great many farmers who own acre ponds should not have a supply of fish in the second or third year if they know how to take care of a pond and have plenty of vegetation in it. I generally give them goldfish as a food fish for other fish. They usually want black bass and nothing else. I give them what they ought to have rather than what they want.

MR. BOWER: What is the amount of infall in this pond and what is the amount of water in the spring?

PROF. DYCHE: There are two 4-inch iron pipes which convey the overflow from two other ponds to keep it at standard height. The pond was practically stagnant* as are most of the ponds in Kansas. Notwithstanding the fact that the carp and goldfish were in there the water was usually clear, except in spots 40 to 50 feet across where the water was sometimes roily.

MR. TITCOMB: Did you have crawfish?

PROF. DYCHE: We have them in all the ponds, but if they get too numerous we stock with black bass, which is the only cure I have for them.

PROF. REIGHARD, of Michigan: What were your expenses and have you figured the annual profit per acre, so as to compare it with what it is possible to make on an acre of land?

PROF. DYCHE: We were running the hatchery for the State and managed this pond in connection with others. No account was kept except of food that we fed the fish in the spring and during part of the summer when we thought food was needed. We never figured out the expense or profit in any way. Our main object was to see how many and what sized fish we could produce in a given length of time.

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*Meaning that there was no overflow, but the water was clear and good.

ONE YEAR'S WORK AT THE KANSAS STATE FISH HATCHERY

By Professor L. L. Dyche.
State Fish and Game Warden, Pratt, Kansas.

One year ago the pond system of the new Kansas State Fishery Hatchery was being built. The earth embankments were all completed in the rough by the middle of October. The entire system of over 80 new ponds with their cement water transmitters fitted with gates was ready to be tested at this time. Exercises appropriate for the occasion were held in the presence of about five thousand visitors.

WATER TURNED IN.

The gates were opened on the 29th of October and the water turned into the 21-inch supply pipe at 10 o'clock A. M. Only about half a head of water was turned on, but it reached the receiving pond that borders the west end of the hatchery in less than thirty minutes. One-half hour later a full head of water was running and it flowed into the hatchery from a receiving chamber over an iron weir plate, in a stream five feet wide and about six inches deep, delivering over 125,000 gallons per hour or about three and one-half million gallons per day. The ponds to be filled were all new and had never had any water in them, except a small amount from local rains. It was estimated that it would take about sixty days to fill these ponds as the banks were new and it was thought that the seepage would be very great. The ponds were all filled, that is, to standard height, which means six feet of water in the deepest place, in a period of less than forty days.

GOPHER BURROWS UNDER EMBANKMENT.

It was soon discovered, however, that in places the seepage was great and that there were many leaks due to the fact that there were a great many gopher tunnels that led from one pond to another and through the outside embankments. Gophers were very common in the ground on which the hatchery was built; it was an alfalfa field before it was converted into fish ponds. The ground was plowed a foot deep but this did not destroy the gopher burrows as many of them were found to be from sixteen to eighteen inches below the surface. The gophers had also made some holes in the new embankments. It became necessary to drain the ponds and to fill them, one, two or three at a time. Digging into the banks and stopping the gopher holes proved more of a task than was expected. After the burrows were located and the banks properly dug away, the holes were stopped by pushing burlap into them, then tramping with dry dirt and finally placing a sack of earth over the hole. It took much time and labor to dig and find the burrows and their many ramifications and to follow them up to places where they could be successfully fixed. It frequently happened that there were tunnels that crossed and connected with other tunnels that led from one pond to another. This made it necessary to do a great deal of digging before the leaks could all be plugged. Only about twenty ponds were fixed before it was necessary to turn the water into the entire system. The gopher burrows caused no end of trouble in the ponds where they were not repaired. We hope to have them all repaired before it is time to stock the ponds next spring. If we ever build another system of ponds, we will surely see to it that the gopher burrows are plowed or dug up before any embankments are constructed.

WAVES CUT NEW BANKS.

The banks were soft and the March winds caused the waves to cut them badly in places. However, this action of the wind and waves was anticipated and was provided for by having the embankments built plenty wide and about two feet higher in most places than they were to be when finally finished.

The water was allowed to flow into the ponds until it stood from twelve to twenty-four inches above normal or standard height. The March winds caused the waves to lash the banks continually and washed some of them to their tops and did a good deal of cutting into their sides. Early in April the water was lowered from a foot to eighteen inches and it was found that the waves had washed the dirt from the banks so as to make a fine natural beach around each pond; it was also found that there was plenty of earth remaining to finish the embankments and make good roads over them anywhere throughout the pond system.

PROTECTING THE NEW BANKS.

Experience had taught us that banks protected with a growth of swamp grass withstood the action of the water best. It so happened that there were a few acres of swamp grass on the hatchery grounds. Swamp grass sod was turned up with a sod plow in strips sixteen inches wide and cut in pieces from sixteen to twenty inches in length. When the water in the ponds was at normal height the sods were laid and tramped into the mud just above the water line. This made a band or border of sod sixteen inches wide around each pond. It took about twelve miles of this sod band to encircle all the ponds and, like fixing the gopher holes, used up much time and labor. During the summer the grass has grown in many places as much as two feet in height and has begun to spread some. By next spring we think that the banks will be fairly well protected. In other ponds where the grass was planted three years ago, it has grown to three or four feet in height, and is a fine protection to the banks and incidentally to the schools of young fish that feed near the water's edge. Waves do not seem to make any headway cutting the banks where this grass has a good start. However, this variety of grass does not grow well on pond banks in a dry climate except for a distance of about two feet above the water line. Thus far, we have not found a good grass for the top of the embankment. Bermuda grass answers the purpose, but it winter kills in our climate. The natural grasses that grow on the banks are fox tail and sandbur grass, both are extremely hardy but neither is very desirable. Among other things we expect to try white clover which has been found growing in a few places on the banks of the old hatchery.

FINISHING THE EMBANKMENT.

After the waterline of the embankments had been sodded with swamp grass, the work of putting the embankment in good shape was begun. Plows, harrows and king drags were used. The embankments were crowned or rounded from one water's edge to the other, but made flat enough on top for good roads. We do not care to have the embankments more than two or three feet higher than the standard water height of the ponds, the lower the better, so that good driveways can be maintained between the ponds.

THE WATER SYSTEM.

Water for the hatchery is received in Pond No. 1 through a twenty-one-inch pipe which carries it from a receiving pond 1 1-3 miles to the west. Pond No. 1 is a long pond and extends north and south across the west end of the hatchery. From Pond No. 1 water is distributed to five chains of ponds that parallel each other and stretch for a mile to the east. There are from sixteen to twenty-one ponds in each chain. Each string of ponds is connected with Pond No. 1 by a ten-inch pipe. If it is desired to drain Pond No. 1, the five gates controlling the five ten-inch pipes are closed. By placing two or three eight-inch flashboards over the iron weir the water from the twenty-one-inch pipe can be turned into the second part of the receiving chamber which is just back of the first part and separated from it by a cement partition. From this second chamber there are also five ten-inch pipes that carry the water under Pond No. 1 and connect with the five chains of ponds. This makes it possible to stop the flow of water into Pond No. 1 when it is necessary to drain it and at the same time keep it running through the five chains of ponds that make up the main body of the hatchery.

In other words, there are, all told, ten ten-inch pipes that carry water from Pond No. 1 to the five chains of ponds that make up the pond system of the hatchery. Nearly all ponds in the five chains of ponds are connected with adjacent ponds by two ten-inch pipes and each pond in a chain that extends east is from six to twelve inches lower than the one west of it. This gives a good gravity flow to the water through the system.

The gates that control the water in the pipes and the wire screen gates that control the fish, are all set in solid cement structures called water transmitters. The new water system seems to work well, though in places the new earth that was not yet compact and had no vegetation to help hold it, washed down and somewhat interfered with the wire screen gates in the cement water transmitters. Where the ground was compact, but little trouble was experienced, and after another year or two, when the ground has settled and is covered with vegetation we expect but little, if any, trouble. It will be two or three years before these ponds and embankments can be put in good shape. It takes time for banks to settle and for vegetation to get well set.

STOCKING THE NEW HATCHERY.

As spring began to advance, many plans were made for stocking the new fish hatchery. The ponds were new and without any vegetation. About one-third or one-half as many spawners were placed in each pond as would have been placed in them if they had been well supplied with vegetation. The ponds were stocked in the last part of April and the first part of May. In less than a month after black bass were placed in them, schools of young fish were seen near the shore. Schools of young crappie were seen in June, bull-heads and blue-gills appeared in the latter part of July and the first part of August.

NATURAL SUPPLY OF PLANT LIFE.

The supply of water for the hatchery comes from the Ninnescah River which is only a creek in size. This river is well supplied with vegetable matter. The water brought many forms of life, both animal and vegetable, into the ponds and it was soon observed that various kinds of water plants had started to grow along the shores. Several kinds of water plants, including "mosses"* and lilies, were planted in the ponds. All this vegetation has done well, and at the present time there is a very fair start of water plants in most of the ponds.

FISH IN NEW PONDS.

So far as we have been able to observe, the fish also have done well. Many schools of black-bass, crappie, blue-gills and bull-head catfish have been seen in the ponds. We estimated some of the bunches that were observed feeding along the shore in July and August at from five to twenty thousand young fish. These young fish have also made a fine growth. On August 23 young black-bass, from three to six inches in length, were seined from one of the new ponds. They were large enough to take full-sized grass-hoppers and to be caught on a hook baited with a grass-hopper.

NUMBER OF FISH AND WATER CONDITIONS.

Just how many fish we have, cannot, of course, be estimated with much certainty at the present time. However, we have reason to believe that if the fish could be moved early this fall, that there would be anywhere from fifty to one hundred car loads, estimating from five to ten thousand to the car load, depending on size and kind of fish. We had planned to begin the distribution of these fish about August 1st. However, water conditions in Kansas have been most unusual this summer. It is one of the dryest years, taking the entire state into consid-

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*The chara, the water milfoil, and most water plants with finely divided leaves are usually, though incorrectly, called "moss."

eration, that has been experienced, perhaps the dryest, since the historic dry year of 1860. Many good Kansas streams are very low, and some of the smaller ones have dried up except for certain pools of water. The large rivers are very much below normal for this season of the year. Many of the ponds not well supplied with water have gone dry. The temperature during a part of July and the month of August surpassed the 100 mark nearly every day for many days in succession. Under such circumstances it has been necessary for us to hold the young fish. Every bass fish culturist knows what great losses occur when young black-bass are held in ponds where there is not a good growth of vegetation and where they cannot be sorted and specially cared for. It will not be possible to deliver fish until water conditions have improved. There will be a great demand for fish when the ponds and streams regain their normal supply of water.

FISH RAISED ON NATURAL FOOD.

The fish raised in the hatchery this season, raised themselves, so to speak. The spawners were simply placed in the ponds and allowed to remain there. They were given no food other than what they found in the water. The Department has been so busy with buildings, grounds and office business that the fish culture work seemed but a side issue. We hope to be able in the near future to give more attention to the fish business and make it the chief business of the Department.

However, we do not expect to feed fish at the hatchery except on a small scale and when experiments are being performed. We hope to so stock the ponds with plants, animals and fish that there will be a natural supply of food for both old and young fish. The fish that eat vegetable matter and waste, so to speak, such as carp, goldfish and hickory shad, will be made to supply food to a very large extent for the game fishes. In other words we desire to convert the natural plant and animal wastes of a pond into fish food and food for fish. To illustrate, both goldfish and hickory shad convert great quantities of waste into a fish flesh that is fine food for other fishes. We hope to raise fish by utilizing the natural products that the water produces.

The owners of ponds and small lakes in our part of the country have little or no time to feed fish. The ponds should be stocked with the proper kinds of vegetation which in itself not only serves as food for many fish but produces the many forms of animal life that fish, especially small and young fish, live upon. We desire to especially mention the blue-gill sunfish as a general utility food fish for man and for fish. This fish spawns late in the season and is very productive in our ponds. The young blue-gills, which appear in great numbers in the latter part of July and in August, make a fine fall and spring food for the young bass and crappie. The blue-gill itself seems to be a rather omnivorous feeder, eating more or less vegetable matter and various forms of small animal life.

BUILDINGS.

On the 19th of September, a year ago, the contract was let for the building of "A Kansas State Fish and Game Building," a power house, five cottages for employees, a residence for the Warden, a barn, a workshop and fifteen tool houses. This group of buildings is just about completed and will furnish homes on the grounds for the permanent part of the working force of the hatchery. The Fish and Game Building is built of concrete and bricks with a green tile roof and is fire proof. The main part of the building is 70 by 52 feet with an addition 65 by 42 feet for an aquarium. On the second floor of this building, the Department will have its general offices. On the first floor will be found laboratories where various kinds of scientific work will be carried on in connection with the general work that is being done by the Department. There is a small aquarium consisting of a series of twelve tanks that hold on an average 540 gallons of water each. These will be used for carrying on experiments as well as for exhibition purposes.

HATCHERY GROUNDS FENCED.

The size and unprotected condition of the hatchery grounds made it possible for certain loose-jointed persons to enter upon the premises at night and commit various depredations. Parties were caught fishing in the ponds. At different times it was discovered that the water gates had been tampered with, either the water was cut off, turned into the drain pipes or wire screen gates were disarranged. After a conference with Governor Hodges, who personally investigated the matter with us, it was decided that it was necessary to fence all the hatchery grounds, about 200 acres, including the fifteen acres where the dam and intake are located.

The work of placing a stout two-inch diamond mesh steel "Elwood" fence around the hatchery grounds is nearing completion. We soon discovered that there was a good deal of work connected with the fence business, as it takes more than three miles of fence to enclose the grounds. This fence is being strung on iron posts. There are two barbed wires at the top, which makes the fence six feet high. All corners and gate posts as well as the braces have been set in solid blocks of concrete that are twenty inches square and extend into the ground for a distance of three feet. With this fence completed it ought to be possible either to keep marauders and meddlers off the grounds or to apprehend them before they can get away.

By another year we hope that the building work will be finished and that we will be in the fish business.

DISCUSSION

Mr. Nesley, of New York: I would like to inquire whether Professor Dyche raises the small-mouth or large-mouth black bass.

Prof. Dyche: We raise only the large-mouth bass; the small-mouth bass has disappeared in competition with the large-mouthed when placed in certain Kansas waters.

Mr. Bower, of Michigan: Will Professor Dyche tell us what has been the expense?

Prof. Dyche: I have not figured it out yet, but I think it is about $150,000, though it may be more than that. I am spending all the money I can get to develop the hatchery.

Mr. Woods, of Missouri: I wish to offer to Kansas, adjoining my own State, congratulations for its remarkable work along this line in which we are all interested.

THE PRIVATE FISH POND--A NEGLECTED RESOURCE

By C. H. Townsend, *Director of the New York Aquarium.*

The possibilities of small fish ponds as sources of food for the people have received little consideration in this country and the actual breeding and maturing of fishes in such ponds is an art which we have yet to put in practice. While certain foreign countries have long profited by the art of private fish culture, and have furnished notable examples, our own facilities for this industry have been neglected. It is probable that our resources in this respect are greater than those of other countries, as the United States already lays claim to the most extensive fish cultural operations carried on in the world, and nowhere is there so large a body of professional fish culturists as that connected with our national and state fishery commissions.

In these times when the value of running streams for water power is being widely considered, the possessors of brooks, springs and small lakes should be awakened to the value of their home resources for water farming. At a former meeting of this Society I had the privilege of describing at considerable length approved methods for the construction and care of small fish ponds.* The matter is recorded in the printed transactions of the Society, and it is unnecessary, at the present time, to reconsider the methods of pond management, but it is always desirable to keep the subject of private fish culture before the public.

It is gratifying to note that trout culture, in the hands of the private citizen, is making some progress in Massachusetts and adjacent states, and the advertisements of successful trout raisers may today be found in American journals devoted to fish and game. Trout culture is,

*Transactions of the American Fisheries Society, 1907. "The Cultivation of Fishes in Small Ponds," by C. H. Townsend, pp. 128-139.

however, a branch of the work which requires special conditions, such as purity of water, comparatively low temperature, the construction of buildings and artificial fertilization. The possibilities for the private or commercial culture of many other kinds of fishes, which are more widely distributed than the trouts and can be cultivated by simpler methods, should receive serious consideration. North America is abundantly supplied with hardy fishes which are available for this purpose. There are no serious difficulties in the way of obtaining them for breeding, and under cultivation they would yield a food supply which would supplement to an important degree that derived from the public fisheries.

In Europe the cultivation of carp is carried on extensively. This fish is now abundant in American waters and, while not comparable with many of our native species, already contributes annually many millions of pounds to our market supply. Despised by many, it is nevertheless marketed more profitably each year in most of our large cities and there is now no doubt that the carp is destined to supply a considerable amount of our fish food. The methods of carp culture, as practiced in Europe have been frequently published in this country and are available for use. It is unquestionably the easiest of all fishes to raise, and it is only necessary to turn to the weekly New York market reports for assurance as to its money value and extensive use. But it is our native fishes which I wish to consider especially in this connection, as many of them have been proved available for cultivation and are more acceptable as food to our people than the carp. Among them may be mentioned the various species of basses, perches, sunfishes and catfishes, which are well distributed in our eastern states, and there are other species inhabiting our western and southern states which are also available for pond culture.

My connection with a public aquarium has brought me into correspondence with many persons who have desired to undertake the raising of fishes, but whose efforts have been limited to the mere stocking of natural ponds. Comparatively few have realized the necessity of proper equipment and actual cultivation, which involve the complete control of the waters and of the fishes contained therein. Very little can be accomplished with a single natural pond; it is necessary to have several artificial ponds which can be readily controlled, while the various operations of pond culture require frequent attention and considerable actual labor.

The requirements for the successful management of several kinds of pond fishes have already been worked out at public fish hatcheries and there is more or less official information on the subject. It is not necessary at present to give instances where success has been achieved; my object, as already stated, is to keep before the public the fact that success in private fish culture is possible and that considerable fish food may be produced with the same amount of labor and intelligent effort that is necessary for the raising of fowls. There has been much agitation over the high cost of living, and it is time to consider what the individual citizen can do in the way of assisting in the production of fish food.

In some of the countries of central Europe the cultivation of fishes in private waters has been going on for centuries. In Austria and Germany fish farming, as it is often called, is a common industry. While it is much practiced by small land owners, there are many large estates which maintain hundreds of ponds in active cultivation. Much of this private fish culture is based on the various forms of the carp, but other European fishes are also cultivated for sale, such as the tench, ide, rudd, bream, perch and pike. Some European fish culturists are now raising American basses and perches. There are many villages in Austria where fish ponds are maintained at the expense of the community. In view of these facts, it is remarkable that immigrants from Europe have neglected to practice their ancient art of pond culture in this country.

Aside from commercial trout raising, which is practiced to a limited extent, we have nothing of such pond culture in America. Our numerous fish hatcheries maintained under the direction of state commissions are devoted almost entirely to the stocking of public waters with young fishes. Very little of the product is reared to maturity and none of it is sent to market direct. If our fish culturists could be commanded to bring their annual yield of fry to maturity and deliver it to the market, they would be at a loss how to proceed. We are really not fish raisers, but producers of fry. At that stage our efforts cease. The rest is left to nature, and negligently cast into waters that we imperfectly protect and utterly neglect to keep pure. While our achievements in public fish hatching are notable, private fish culture has made no headway. A few of our state fish commissioners are making efforts in pond culture for the benefit of farming communities, notably in Kansas, and it will be interesting to observe what progress can be made. Perhaps the vast natural yield from our coast, lake and river fisheries is responsible for the lack of private effort.

Our fish supply, in general, is large and well distributed, but we could consume a much greater supply, especially in view of the fact that in some sections the natural supply is being depleted by over fishing and pollution of waters. There are many sections of the country inadequately supplied with fish food which could be produced locally by pond cultivation and such supplies would find convenient home markets.

It is possible for the private citizen to obtain pond fishes for breeding purposes, but he needs assistance and direction. Object lessons on approved methods of fish culture could be obtained by visiting public hatcheries, but this is not likely to be undertaken. It would be advantageous to the country if state fish commissions generally could supply the coarser fishes for cultivation in private waters and furnish the public free information as to the methods to be followed.

We should not rest content with the mere fact that such information exists in public documents. The editions of state documents are neither large nor well distributed, and rural populations may remain unaware that useful fishery information may be had for the asking. State fish commissions should not only prepare inexpensive pamphlets on the cultivation of common fishes, but see that they reach many communities and be announced and reviewed by the rural press everywhere. Model ponds distributed about the state for demonstrative work would, of course, be educational, like agricultural colleges and state experiment farms. I am not prepared to set forth the best means of doing this work, perhaps no two states would undertake it the same way.

I am convinced that some of the energy put into the production of fry is misdirected. The output is amazing; six billions last year by the National Bureau and perhaps as much more by the states. Practically all of it is hurried into the nearest river and none of it raised. We are all doing about the same thing and have settled into the rut of fish hatching in hatchery buildings. No one is doing anything new except as connected with the competition for increased output.

Having practiced these wholesale methods for two or three decades, let us now consider whether we might not profit by a little less fish hatching and a little more fish raising. Does salvation lie only in a multiplicity of expensive federal and state hatcheries? If our fishery establishments were equipped to raise and market one per cent. of the fry now being hatched and liberated, might not the quantity of food thus produced exceed that which eventually reaches market by way of the public waters? Let us simplify our art and teach it to the people, for they can surely help in the production of fish food.

DISCUSSION

Professor Ward (in the chair): The place which the Society has accorded this paper is sufficient evidence of its value. To open the discussion I will call upon Mr. E. S. Casselman, who, I understand, has had a very large experience in the building of such ponds for a private fish supply.

Mr. Casselman, of New York: My experience has been with large ponds, 75 to 200 acres in extent. We have used small ponds merely to provide food.

Mr. Nesley, of New York: I am engaged in private fish culture work, developing property in Columbia County, New York, belonging to a man from New York City. There is a lake with a circumference of six or seven miles, and running down to fifteen feet in depth. We will put in about twenty ponds this fall. We expect to specialize in the production of small-mouth black bass and perch in a commercial way. Perhaps in another year I may be able to report upon the results of our work.

Mr. Titcomb, of Vermont: In our State the man who has an artificial pond is not subject to the closed season covering public waters, and he can take his fish at any time of the year, just as he can take his poultry. I think it should be so in every state. This does not interfere with the enforcement of laws for the protection of fish in public waters.

Prof. Dyche, of Kansas: Dr. Townsend's paper has interested me greatly and has suggested a number of things for me to do. In building fish hatcheries and in carrying out certain experiments I have followed up suggestions given in some of Dr. Townsend's former papers, and I propose to continue further experiments in line with some of his suggestions made here today.

NOTES ON STRIPED BASS

By J. P. Snyder.

As Mr. S. G. Worth in his reports to the Bureau of Fisheries and to this society in years past has fully covered the method of handling striped bass there remains but little for me to tell.

This fish, as is well known, leaves the sea and ascends our coast rivers each spring to deposit their eggs. Those entering the Roanoke River collect on the sand and gravel bars below the rapids at Weldon, N. C. Here they assemble in large numbers, moving but little until the water temperature reaches 67 or 68 degrees Fahr. Then they become active, ripen quickly and immediately begin spawning. If the water is clear enough for the males to find the females there will usually be a dozen or more around each female when in the act of spawning, for at such times, almost invariably, a number of male fish, perhaps a dozen or more, are taken in the same lift with a female. This is the exception when the water is muddy. In spawning the female seeks the sand beds where she frequently comes to the surface and vigorously lashes the water with her tail.

The fishing is done with bow nets which are very similar to landing nets, only larger, being about seven feet in diameter and having a handle about twelve or fifteen feet long. Formerly all the fishing was done from dugouts, but in recent years gas boats have replaced them to some extent.

Previous to the spawning season the Bureau of Fisheries establishes numerous depots along this part of the river where pans, buckets and dippers are stored for the use of fishermen in taking and caring for the eggs until they are delivered at the Bureau's hatchery near Weldon. Formerly spawn-takers were employed to take the eggs, but recently all the eggs have been taken by the fishermen. When a female fish is caught she is immediately examined, and if ripe, the men hurry to the nearest depot. While still alive the abdomen of the fish is ripped open and the ovaries carefully removed. The membrane surrounding the eggs is then cut and all the loose ova are poured into a pan. When a large fish is taken more than one pan may be needed to hold the eggs. Live male fish are taken and their milt is ejected over the eggs. As the fish die quickly and the eggs and milt die with the fish the men must usually act hurriedly. Unlike the shad and some other fishes the eggs from a dead striped bass cannot be fertilized, even though the fish has been dead but a few moments. As soon as the eggs and milt are in the pan a little water is added and the pans are then tilted until the milt is thoroughly incorporated with the eggs. When first taken the eggs are very small, but they rapidly expand to many times their former size. During this time they must be thinned up and given more and more water and the pans must be agitated frequently or many eggs will not expand fully and soon die. When fully expanded they are put into buckets and taken to the hatchery or they may be taken in the pans while expanding and may even be placed in the jars with good results before expansion is completed, but when unexpanded eggs crowded in buckets are invariably lost.

In the hatchery they are placed in the McDonald jar having the brass top and glass and rubber intake tubes just as in shad work, but in this case the nickeled rim holding the brass top in place has a pitcher lip and no discharge tube is used. The water falls directly from the pitcher lip into the aquarium. Usually this fall is but two or three inches but experiments with greater amount of fall revealed no bad effects. In this my experience has been different from that reported by Mr. Worth.

The eggs are semi-buoyant, more so than those of the shad and whitefish and are nearly transparent. During incubation the egg or rather the vital part of it occupies but a small part of the space within the egg membrane. As it is heavier than water and light green in color the vitellus is easily seen lying on the lower inner part of the egg membrane and it keeps to this position as the egg circulates in the jar. Incubation is completed in from thirty-six to forty-eight hours depending upon the temperature of the water. At first the fish are very weak and lie on the bottom of the aquarium but every few moments they struggle upwards for an inch or two then drop head first to the bottom. Gaining strength, they rise higher and higher, and in twenty-four hours all have left the bottom and swim about in the aquarium. The shells of the eggs are very light and it is impracticable to keep them from leaving the jars and passing into the aquaria. Here they collect on the bottom of the aquaria, and, in this warm water, soon decay and seem to poison the water, for, if the little fish are left in the aquaria with the shells, nearly all of them will die before they are two days old. To avoid this, as soon as the fish swim up well they are carefully transferred to clean aquaria, and in this case there is practically no loss unless they are weakened by lack of food when held too long. Those that cannot be transferred to a clean aquarium without taking up egg shells are taken out and planted.

As all the eggs are taken by fishermen, often under adverse conditions, and as special care is required in caring for them in the field, it is not surprising that a larger percentage of the eggs received fail to produce fish. This is especially true when it is understood that on an average a given fisherman does not capture more than one spawning fish in two or three years, and that it is only five years since the fishermen began taking the eggs themselves. Yet, during this time the percentage hatched has arisen from less than fifty per cent. to seventy per cent., so that, although we did not receive quite as many eggs last spring as on two previous years, we hatched more fish than ever before. To illustrate how little opportunity one has to experiment and study the handling and care of these eggs in the field I may say that during the past four seasons I have spent many days and nights on the river with the fishermen and have taken the eggs from only five fish, which were all the ripe fish I saw caught. In closing I want to ask this question: "Has it been proven that these fish will not ripen in crates?"

DISCUSSION

PRESIDENT: The members present may remember that the striped bass was introduced on the Pacific coast twenty-five or thirty years ago, and has been one of the notable successes in the transplanting of market fish. They are perhaps more abundant on the Pacific Coast to-day than on the Atlantic. The shad is another unusual example of the same thing.

MR. BOWER, of Michigan: Were the shad and striped bass taken to the Pacific Coast as fry or eggs?

PRESIDENT: My impression is that the hatching was going on en-route and that they were practically all hatched by the time the Sacramento River was reached, and that they were planted as very young fry.

Note: As late as 1876, shad fry were taken from Holyoke, Mass., to the Sacramento River and deposited alive at Tehama, Cal.

T. H. BEAN.

IMPROVEMENT OF FISHING THROUGH A KNOWLEDGE OF THE BREEDING HABITS OF FISHES

By Prof. Jacob Reighard, *University of Michigan.*

When the breeding season approaches most fishes leave their usual haunts and travel a longer or shorter distance to their breeding grounds. The distance travelled may be a few rods, as in the common sunfish, or it may be hundreds of miles, as in the salmon. In any case it brings the fish into new surroundings. Here it seeks certain definite conditions which vary with the species. Some of the fish require swift water, others quiet water; some seek a bottom of sand or gravel free from vegetation; others seek a bottom on which there is vegetation, so that they may attach their eggs to its rootlets (which they expose in making their nests) or hang them in masses from its branches. Each chooses a breeding ground suited to it. Compared to the total area frequented by the fish of any water, the breeding grounds are of limited extent. It results that the fish are crowded together on the breeding grounds as well as in their approach to the grounds. This, in many cases, affords unusual opportunity for their capture. The whitefish is a notable instance of this.

The sexes are brought together on the breeding grounds. At the instant when the eggs are laid there is, in all known cases, intimate contact of the body of the female with the bodies of one or more males in such a way that the vents of the two sexes are brought together. When the eggs are expelled the water is at the same instant filled with a cloud of milt. Every egg is at once surrounded by hundreds, thousands, perhaps millions of sperms, each seeking to penetrate it. Under such circumstances fertilization is practically certain. It is a popular error, from which fish culturists are not altogether free, that a large percentage of eggs remain unfertilized in nature and that these consequently die. It is commonly held that by resorting to artificial fertilization with its high percentage of impregnation, the fish culturist, by his method of fertilization alone, saves eggs that would otherwise perish. The fish culturist saves without a doubt, but not by his method of fertilization, for that is no more perfect than in nature. It is in truth, probably less perfect. In nature the eggs are laid only when thoroughly ripe and only in the presence of the fertilizing male. In spite of all his care the fish culturist, on the other hand, spawns females that are unripe and overripe and loses a considerable percentage in this way. He often finds eggs, naturally laid, a large percentage of which are dead, and may assume that these have not been fertilized. Under normal conditions the eggs that are unfertilized do not undergo cleavage and do not therefore form a blastoderm. If eggs are collected from natural waters shortly after they have been laid and while all of them are still living, it is found that practically all of them have undergone cleavage or that this has proceeded until a germinal disc has been formed. This in the early stages is the only criterion of fertilization. If the eggs are collected somewhat later many of them are dead and partly decayed and it is then impossible to tell whether or not they have been fertilized. To assume that they have not been fertilized is to ignore all that we know of eggs collected shortly after they have been naturally laid. I have collected from the natural waters the recently laid eggs of many fish and have failed to find any considerable number unfertilized. The gain of the fish culturist is therefore not in a higher percentage of fertilization, but rather in the protection afforded the eggs after fertilization.

The eggs may be laid in nests prepared by the male parent and are in that case protected by him until they hatch, or as in case of the black bass, until the young are well grown. Nearly one fifth of the species of fishes that occur in Michigan are known to build nests, and give their eggs, by this means, a protection analogous to that afforded by the fish-culturist. But the majority of fishes build no nests and their eggs suffer from many enemies.

The features of interest to us in our present discussion of the breeding habits of fishes may be summarized as follows:

1. At the breeding season fishes migrate from their ordinary haunts to the breeding grounds.
2. Each species selects a breeding ground characteristic of it. It shows a preference with respect to the character of the water (warmer or colder, clear or turbid, quiet or running), with respect to the nature of the bottom (sand, gravel, marl, muck, mud) and with respect to the presence or absence of plants.
3. Both sexes are present at the same time on the breeding ground. Their bodies are in intimate contact at the moment of laying of the eggs and practically all eggs are fertilized.
4. Some species construct nests for the protection of the eggs. Others construct nests and guard the eggs. Others continue the guardianship for a longer or shorter time after the eggs have hatched. Most species do not construct nests and do not guard the eggs or young.

In order that fishes may thrive in any natural water it is necessary that there be sufficient food and that there be available breeding grounds suited to each species. Most fishes are not *narrowly* limited in their choice of food. They are capable, with few exceptions, of utilizing the available animal food. Their choice of breeding grounds is more limited. Yet in attempting to determine the suitability of a particular water for a given fish, far more attention has been paid to food than to breeding grounds. Of the two factors the latter is probably the more important.

UTILIZATION OF OUR KNOWLEDGE OF THE BREEDING HABITS OF FISHES.

1. *Selection of Waters in Which to Plant Fish.* In the earlier days of fish culture in Michigan whitefish and wall-eyed pike were planted in many inland lakes. In a few of these the adult fish were afterward found, but in most of them the water remained as barren of the planted fish as before the planting. Conditions were evidently unsuitable, but in what respect? In most of the lakes thus planted it is probable that there was sufficient food for the adults of either of these species. But if suitable breeding grounds were lacking it is likely that conditions were in some way unsuited to the planted fry. In the case of the whitefish we have an imperfect knowl-

edge of what are appropriate breeding conditions; in the case of the wall-eyed pike we are, I believe, still quite ignorant. It seems to me useless to introduce the fry into waters in which suitable breeding conditions are not known to exist. We need more knowledge. In the absence of this, it is best to plant only in waters in which the fish are known to be already breeding, and to introduce the young, if possible, on the breeding grounds. Small-mouthed bass require clear water and gravel bottom for breeding. Large-mouthed bass prefer plant-grown bottom and are more tolerant of turbid water. Suckers require running water and gravel bottom. It is unwise to introduce any of these forms into waters lacking in the conditions peculiar to its breeding activities. What is true of these species is equally true of others.

2. *Preservation of Breeding Grounds.* The ditching of streams and the lowering of lake levels by this or other means need not seriously affect the food supply of many fishes whose breeding grounds it destroys. The common sucker, red-horse, the stone-roller and several species of valuable bait minnows lay their eggs or build their nests on the ripples of the smaller streams. Ditching such a stream destroys these breeding grounds. They may be restored by the meandering of the stream which forms new ripples by depositing in its bed materials eroded from its banks. But in the meantime the increase of suckers or bait minnows may have been seriously checked. If the stream is kept straight by repeated ditching these fish may disappear from it.

Where lake levels are lowered the breeding grounds of the majority of fishes may be destroyed. The pike lays its eggs in the marshes or on the shallowest weed-grown bottom, often on over-flowed meadows. The basses and sunfishes and the bullheads build their nests on the shoals in water usually not over two feet deep. The blunt-nosed minnow, food for the large-mouthed bass and pike, the Johnny-darter and the miller's thumb, lay their eggs under stones very near the shore. When the shoals are laid bare the breeding grounds of all these forms are destroyed, or greatly limited. The new shore is usually of soft mud or marl without the stones needful for the small-mouthed bass and the smaller fishes mentioned above. From the shore the water deepens rapidly so that few shallows are left for any of the fishes. Lowering the lake level has thus destroyed or greatly limited both the food and the breeding grounds of the game fishes.

Raising of lake levels by damming their outlet may have a like effect by making the water over the shoals too deep for breeding fish. In this case new shoals are usually created by the overflow of flat lands and the fishes in time utilize these as breeding grounds.

It is evident that in all these cases the prolonged action of natural forces has brought the lakes and streams into such a condition that they afford to their native fishes both food and breeding grounds. The majority of fishes are more accurately adjusted to breeding conditions than to food. These conditions must be maintained or the fishes will greatly diminish or disappear.

3. *Protection of Breeding Grounds.* We are accustomed to protect fishes by forbidding fishing during the breeding season. The breeding season is not fixed by the calendar and may begin before the closed season or continue after it. The closed season is commonly too short to cover the breeding time, and the fishes suffer. In most waters there is always an open season for some fishes and the waters are never free from anglers, who are tempted to take whatever fish they can get, whether protected or not.

The breeding grounds, on the other hand, are of limited extent and may be definitely located by one who has knowledge of breeding habits. They may be marked by buoys and fishing on them prohibited while it is permitted elsewhere. For nest building fishes, like the basses, this method might prove more effective in preventing depletion than the present method of pond culture. It need not be more expensive. Under it fishing in a lake would be permitted during all seasons of the year, but prohibited on the breeding grounds during a period long enough to adequately cover all fluctuations of the breeding season.

The presence of fishermen on the lake during the breeding season in greater numbers than under the existing system, should serve to protect the breeding grounds, for they would watch one another. Each would tend to see that others did not encroach on the prohibited areas.

4. *Construction of Breeding Grounds in Ponds That Lack Them.* Shelford (1911) has said that "the breeding interests and the feeding interests of still-water food and game fishes are distinctly antagonistic." As a pond grows older the amount of rooted vegetation in it increases until the whole pond bottom becomes thickly covered by it. The decay of such vegetation adds to the water chemical substances which serve as food for the microscopic plants or algae (Pond, 1905). The algae form the basic food for the microscopic animals. These in turn form the food of younger fishes and from them a chain of nutrient relations leads up to the adult fishes. Consequently as a pond grows older and the number of rooted plants in it is increased it contains more fish food. But this same process which increases the food supply of fishes, tends to destroy the conditions necessary for their breeding. The bottom becomes so thickly covered with muck that there are no bare sand or gravel areas remaining and these are necessary for some fishes. At the same time the decay of the organic matter, which falls to the bottom, may so use up the oxygen in the bottom waters that fish eggs cannot live in them.

If the above statement is correct then it follows that old ponds, which contain few or no fish, may again be made productive. They may be rich in the basic fish foods, but lack the necessary breeding grounds. By removing a part of the vegetation in water of suitable depth so that sand or gravel bottom is exposed in some places and a sparse growth of plants permitted in other places, suitable breeding conditions may be restored. By the introduction of suitable fishes a barren pond thus treated might be made again productive.

I have attempted to show that through a knowledge of the breeding habits of fishes we may hope to preserve or increase our supply of fishes by one or more of the following means:

1. By wiser selection of the waters in which fish are to be planted.
2. By the preservation of existing breeding grounds.
3. By the prohibition of fishing on breeding grounds while permitting it in adjacent waters.
4. By the construction of breeding grounds in ponds from which they have disappeared through the operation of natural forces.

For the fisheries interests a knowledge of breeding habits appears to be more important than a knowledge of food habits. Yet our knowledge of breeding habits is still very meager. One of the purposes of the present paper is to stimulate an interest in them with the hope that thereby our knowledge may be increased.

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DISCUSSION

Prof. Ward, of Illinois: The substance of this paper must be very prominently in mind as it was continually emphasized in the paper by President Townsend and those of you who recall Prof. Dyche's paper of last year will remember that one of the very first things he considered in the construction of ponds was the maintenance of proper breeding areas for the fish. To have successful fish ponds we must take into account the habits of the animals to be kept in those ponds. I was asked some months ago to examine a pond installed by a southern Georgia fishing club, to tell them why they failed to get fish. The pond was just a receptacle containing a certain number of gallons of water, and without any shore area or plant growth whatever. The reason that fishes did not thrive was perfectly evident, but it had not occurred to the members of the club that the fish required any special place to breed. I am confident that many of the failures experienced in private culture are caused by lack of proper breeding places for the fish.

Mr. Nesley, of New York: While working on Lake Erie I found just the condition mentioned by Professor Ward. The southern side of Lake Erie has become so contaminated by the large cities that the majority of the whitefish spawn on the Canadian side. The State Department of Fisheries was compelled to go over on the Canadian side to collect eggs for the reason that the bottom there was not polluted.

A PLEA FOR THE PRESERVATION OF RECORDS CONCERNING FISH

By Jacob Reighard,

Professor of Zoology, University of Michigan.

For five years I have been in charge of the Biological Station of the University of Michigan, situated on Douglas Lake, about fifteen miles south of the Straits of Mackinaw in the Southern Peninsula of Michigan. During this time, more especially during the last year, I have recorded such facts as I could find out about the fish of the lake. In order to study the data collected I have arranged them in tables, one of which is reproduced below:

DATA CONCERNING PIKE (*ESOX LUCIUS*) OF DOUGLAS LAKE, 1911-1912.

Serial number	Weight ounces	Length inches	Sex	Water depth feet	Apparatus	Content of alimentary canal	Locality	Date
1	104	30.6		15	gill	2 four-inch perch	12	7,3,11.
2	28	15		25-30	gill	2 perch, $4\frac{1}{2}$; $3\frac{3}{8}$	3	7,11,11.
3	12	13.2	m	4	gill	fish, not determined	3	8,3,12.
4	15	15.4	f	12	gill	empty	3	8,8,12.
5	15	14.8	m	12	gill	fish	5	8,11,12.
6	16	15.2	m	12	gill	fish	5	8,12,12.
7	21	16.4	m	12	gill	empty	5	8.13,12.
8	30	18	f	26	gill	empty	4	8,15.12.
9	29.5	16.8	m	26	gill	empty	6	8,15,12.
10	26	17	m	26	gill	empty	6	8,15,12.
11	10	12.8	f	26	gill	empty	6	8,15,12.
12	10	12.8	f	26	gill	empty	6	8,16,12.
13	18	15.6	f	26	gill	empty	6	8,16,12.
14	24	17.6	f	26	gill	empty	6	8,20,12.
15	24	17.6	f	13	gill	2 fish	7	8,20,12.
16	29.5	17.2	f	13	gill	2 fish	7	8,20,12.
17	10	13.6	f	26	gill	empty	7	8,20,12.
18	10.5	13.6	m	25	gill	empty	7	8,20,12.
19	25	17.8	f	25	gill	empty	7	8,14,12.
20	27	18.8	m	12	gill	empty	5	8,14,12.
21	12	13.2	m	12	gill	empty	5	8,18,12.
22	59	19.6	m	45	gill	empty	6	8,18,12.

Lengths are measured from the tip of the snout along the side to the base of the rays of the tail fin.

By depth of water is meant the distance from the point at which the fish is taken to the surface, which is usually, although not always, the distance from the bottom to the surface. The localities may be indicated, as in the table, by means of numbers which refer to a map or by descriptive terms. It is convenient for purposes of discussion to indicate each fish by a serial number.

A number of interesting facts at once appear from the table. In July and August the pike in this lake are seen to range from a depth of four feet to that of forty-five feet. This depth-range at this season is explained by the fact that below forty-five feet the water contains little or no oxygen so that the pike cannot live there. At other seasons they may range deeper.

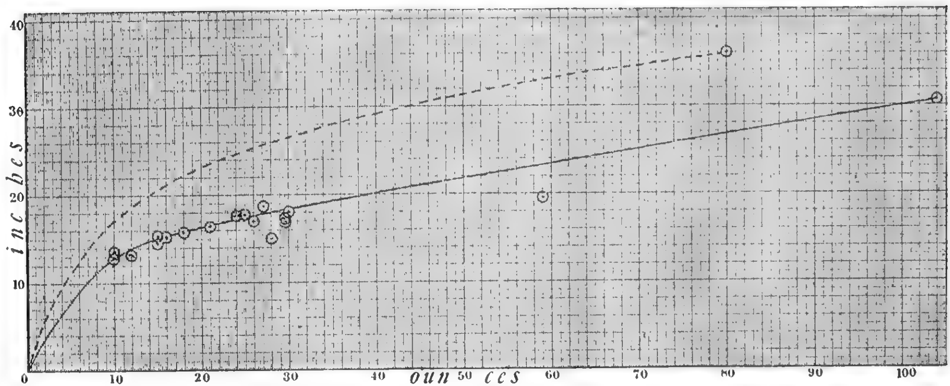
The food, so far as it may be learned from so few records, consists entirely of fish. The four fish well enough preserved for identification were perch. These were taken in spite of the spines of their dorsal fins, a hint perhaps to fishermen.

Of the twenty pike whose sex was determined, half were males. The males averaged about three ounces heavier than the females, but the data are not enough to warrant a general statement on this score.

If we represent the length of each fish by a corresponding distance measured along a vertical line and its weight by distance along a horizontal line we may show the length and weight of each by means of a point. Thus in figure one, each inch of length is represented by a space on the vertical line at the left; each ounce of weight by a space on the horizontal line. The intersection of horizontal and vertical lines drawn from the two points thus located gives a point which shows at the same time the length and weight of an individual fish. Thus the point at the extreme right in our figure indicates a fish of 30.6 inches length and 104 ounces weight. The remaining points indicate the lengths and weights of the pike in our table. Through these points we may draw a curve as shown in the figure. This curve may be drawn with mathematical precision, but that would require a larger number of points than we have for the pike. The curve in the figure has therefore been merely sketched in. It represents the relation between length and weight of the 22 pike in the table. With sufficient data the relation might be expressed by a curve from which it would be possible to derive an algebraic formula.

The curve shows that as the pike grow longer the length increases less rapidly than the weight. Thus between the lengths of fifteen and sixteen inches there is an increase of nearly four ounces in weight, while between the lengths of twelve and thirteen inches there is an increase of but two ounces in weight. In other words the pike increases in weight about twice as much per unit of length between fifteen and sixteen inches as it does between twelve and thirteen inches.

Such a curve may very well be characteristic of the lake. It may indicate whether the conditions in the lake are favorable to pike, or it may have some other meaning. To see whether the curve has any meaning I attempted to find similar data from which to construct a curve for pike from some other locality. I was unable to find them and so far as I know they do not exist. In Forbes and Richardson's Fishes of Illinois the average length of the pike in Illinois is given as 36 inches and the average weight as 80 ounces, but it is not stated whether these averages are made from measurements or are mere estimates. If the point for a pike of 36 inches and 80 ounces is indicated on the chart it is seen, as shown by the broken line, to fall well above the curve for the pike of Douglas Lake. A hypothetical curve sketched through this point is seen to have a different form from the Douglas Lake curve. It rises more steeply and indicates a less rapid increase of weight per unit of length. In other words the pike represented by such a curve would be longer for a given weight. In Douglas Lake a pike of 80 ounces should be about 26 inches long, while in Illinois it is said to be on the average 36 inches



Curve showing the relation between length and weight in the pike (*Esox lucius*) of Douglas Lake, Michigan. The dotted line is a hypothetical curve for the pike of Illinois.

long. It is possible that such a curve represents conditions favorable or unfavorable according to its form, but at present we have no data from which to determine whether this is true or not.

It seems to me important that data such as are included in the table here shown be accumulated. By means of them we should learn much of the *conditions* under which our various fishes live. In addition to the data included in our table there might be added others on parasites, on breeding habits and breeding seasons, conditions of the sexual glands, character of bottom and of vegetation at the point where fish are taken, and possibly on the temperature of the water. A table of the form here indicated is shown below. It is suggested that a data blank of suitable form with instructions for its use be prepared and distributed to members of this society. This might be done by the United States Bureau of Fisheries and the blanks, properly filled, might be returned to the Bureau. In this way information about the conditions under which fish live would be gradually accumulated at Washington. Whenever the observer was uncertain as to a species of fish or the character of stomach contents, the specimens might be forwarded for identification. A study of the accumulated data would certainly add much to our wholly inadequate knowledge of the natural history of our fishes.

FORM SUGGESTED FOR USE IN RECORDING DATA CONCERNING FISH

Number	Weight ounces	Length inches	Sex	Sexual glands	Stomach contents	Parasites	Locality	Depth water	Water temperature	Kind of bottom	Vegetation	Net or tackle	Date	Miscellaneous breed'g habits etc.

1. Each fish should be given a serial number and the data concerning it entered in the appropriate columns opposite its number.

2. Lengths should be measured along the middle of the side from the tip of the snout to the base (not tip) of the tail fin.
3. By depth of water is meant the number of feet from the surface to point at which fish was taken.
4. Under the locality should be indicated name of body of water, and its location, and point in it at which fish was taken.

WORK OF THE PENNSYLVANIA FISHERIES DEPARTMENT.

BY N. R. BULLER,
State Commissioner of Fisheries of Pennsylvania.

Efficiency and economy are the greatest factors in success in the business world and they should be the greatest factors in the work of the officials that have charge of the fishing interests of the Government and the various States. Efficiency and economy are only attained by the use of the best possible methods and the best contrived plans. It was in view of this that the Department of Fisheries of Pennsylvania decided that the way to get the best results at the least expenditure of money, was to concentrate the work on a few plants and make those complete in every detail and up to the highest type of the requirements of fish lore.

There were eight hatcheries in Pennsylvania when the present Commissioner assumed control. One of these had been badly torn up by floods, and at another the water supply and the situation unfitted it for the work it was called upon to do. It was decided, therefore, with the advice of the Board of Fishery Commission, to abandon these two hatcheries and concentrate the work upon the other six, using each one for the propagation of the fish to which it is peculiarly fitted.

Engineers were employed to lay out the grounds and to draw up plans showing the capabilities of each hatchery in the way of the ponds adapted to its water supply. Architects were employed to draw up plans for hatching houses, to be of brick, concrete and steel with an absence of wood except in the window frames. This will make them almost indestructible and obviate constant repairs. The dignity of the Commonwealth of Pennsylvania demands that the buildings and the hatcheries shall be of a substantial and ornamental type that will make them a credit to the State.

From these plans the Department, during the past year, has gradually worked out the solution of the problem it had set itself to solve. At the Corry hatchery the series of ponds necessary to complete that hatchery were partly constructed of reinforced concrete in the best manner laid out by contract, thus insuring expert work. The contracts for the erection of the hatching house and the remaining ponds necessary to complete the hatchery have also been made, and the department hopes by next fall to have one of the most complete, if not the most complete trout hatchery in the United States. The water supply is ample and of the best quality. The lay of the ground is exactly suited for the construction of the ponds and the output from this hatchery ought, for several years, to be fully equal to any demand which may be put upon it.

The Wayne County hatchery is situated in the northeastern part of the Commonwealth, in the region which abounds with lakes that might be said to be breeding ponds for the propagation of such fish as pickerel, yellow perch, sunfish and bass. The capabilities of this hatchery for the furnishing of these fish is limited only by the amount of money that the State will appropriate for the purpose of field work, which is the name the Department gives to the work of gathering spawn and young fish from the various lakes and ponds.

The Department has secured the rights to a former reservoir of the Delaware and Hudson Canal, which has a water surface of several hundred acres, to be used as a bass pond, and this is supplemented by several ponds of varying sizes, which will be used as breeding ponds. The control of the reservoir gives the hatchery the control of the water, so that at no time will there be any danger of shortage of water. The facilities for raising trout at this hatchery are fully equal to any demands upon it in that section of the State. A new hatching house of the substantial character spoken of above will be erected this year at the Wayne hatchery, and it is hoped to have it in use this coming season.

Another important output from the Wayne hatchery is bull-frogs, the tadpoles of which can be gathered in almost countless numbers from the various waters in the vicinity, and the Department will be able to furnish all the frogs that may be needed by applicants in the State. It is a rather curious fact that while these tadpoles may be gathered and shipped by the million this seems to have no effect upon the number of frogs remaining, which appears to be about the same every year.

At Torresdale is situated the shad hatching plant of the Department, and the past year it did wonderfully good work in the matter of hatching and planting shad, although the season was not a propitious one. The water failed to warm to the proper temperature, so that many of the fish hatched too early, but they were planted right off the hatching house and the Department hopes that there was no loss. In this shad work the Department had the co-operation of New Jersey and also, in a way, of New York to which latter State the Department was glad to turn over several million shad. That the work of the Department in the hatching and planting of shad has kept up the stock in the Delaware river is shown by the number of good hauls of shad taken as far up the river as Hancock and Cadosia in New York State.

At Torresdale the hatchery is also used to supplement the other hatcheries in hatching out in its batteries wall-eyed pike, white fish and yellow perch. This hatchery will also be used to furnish blue gills, sunfish and catfish, to the breeding of which the waters are thoroughly suited.

At Erie is situated the hatchery to propagate the lake fishes that go to make up the fishing industries of Erie, the largest fresh water fish port in the United States.

The spawn of these fish from the lake would be wasted were it not for the efforts of the fish culturist. About two years ago there was an epidemic of typhoid fever in Erie and the State Department of Health ordered the water treated, which proved deadly to the fish, and the work of hatching these fish has since been conducted at the Erie Auxiliary Hatchery, situated at Union City, about 18 miles from Erie.

In the plans for the completion of the hatcheries, Erie was, of course, included and to meet the problem of water the Commissioners of Water Works of the City of Erie donated to the Department of Fisheries a portion of the park at the water works. This is located on the lake and the Department's boat can land immediately at the hatchery door the eggs which have been gathered by the fishermen, and receive the young fish to be planted. The last Legislature has made an appropriation which will enable the Department not only to put up a complete hatchery, but at the same time erect a building ornate enough to be in keeping with the beauties of the park. The building will have a capacity to handle any ordinary catch, but it can always be supplemented, if overcrowded, by the batteries at Wayne, Torresdale and Union City.

At Union City much work has been done in the extension and completion of ponds and its success in bass work this year is most gratifying.

It will be understood that while all these works of completion were going on, the work of fish culture was badly hampered, but the Department is glad to say that the results have been most gratifying and every application for fish has been or is being filled in its turn. The Department has adopted a plan of shipping fingerlings, which in the trout run from three to seven inches in length, and in the other fish from two to four inches, except, of course, in such cases as that of the wall-eyed pike where the hatch is so enormous that the fish must be shipped as fast as they are hatched. This sending of the larger fish has met the warmest commendations of the recipients, and there is hardly one applicant who has not written to express his approbation.

The fish when shipped are counted and the applicant receives a notice telling how many fish are sent and asking him to state the number received and the condition. This seems a good innovation, as the Department now knows exactly how many fish were sent to an applicant, how many he received and their condition. It is gratifying to say that not one return in a hundred complains of a loss of more than two or three fish, while all report the condition good.

While the Department has perfected its plans to furnish all the game fish required to stock the streams of the State, yet it knows that the number of anglers who want these fish are but a small proportion of those who go fishing in the State. To the expert angler with his slender tackle there is a thrill when the gorgeous colored trout or the greedy black bass takes his fly and starts to battle for his freedom. But the number of trout streams is but a small portion of all the streams of the State, while the black bass is not suitable for many streams.

To the majority of the dwellers in Pennsylvania, fishing is not only an amusement, but at the same time a means of obtaining a food supply. There is nothing equal to a day or a week in the woods beside a stream, where the sun brings the tan to the cheek and the fresh air a joy to the lungs that is not felt by the dweller in the towns and the worker in the stores and mills. The farmer and the farmer's boy, and even his wife and daughters, enjoy a fishing trip to the streams where they can secure a mess of fish which means a change of diet. At the same time, when they hook the fish with their plain tackle, they feel as exciting a thrill and experience as much gratification as the expert angler who takes the trout or bass with his expensive apparatus.

To this very large majority of fishermen the joy of fishing is brought by the so-called minor fish—the yellow perch, the sunfish and the catfish, together with such native fishes as the chub and the fall fish. All these fish are easily propagated and have great fecundity and the Department will bend every effort to produce these in such numbers that every one may have not only the pleasure of fishing, but the pleasure of taking home a string of fish to eat. There would be no difficulty in keeping these streams stocked with fish but for the wasteful and destructive methods employed by too many persons who have no regard for the rights of others. The man who draws off a dam for the sake of getting a bushel of fish and thereby destroys thousands of other fish has no regard for the Golden Rule. The same is true of the gigger and the seiner, but the Department hopes, with the education of the people to the fact that the streams will be full of fish if they are properly protected, that the days of destructive fishing will soon be numbered.

The Department is glad to say that it finds no part of its work so popular as the plan to fill up the streams with fish for the general public.

The problem of clarifying the streams of Pennsylvania is one of the most serious that the Department of Fisheries has to face. Ever since the settlement of Pennsylvania manufacturers have seemed to regard the streams as open sewers into which it is perfectly proper to discharge their refuse with no thought of the discomfort to the man down stream. There are now about 48,000 manufacturing establishments in Pennsylvania and all, or nearly all of them that have the opportunity, empty their refuse into the nearest stream. The result, of course, has been to foul the streams in such a way that many of them no longer contain any aquatic life whatever, while hundreds of other streams are so foul that the fish avoid them or live in them only in very small numbers.

For two years the Department has pursued a plan of notifying every manufacturer that he must comply with the law which forbids running into the streams any matter deleterious to fish or aquatic life, so that no one can plead ignorance of the law. The prosecution of sporadic cases the Department has found of little value, making no impression. Indeed, in one case where suit was brought against the manufacturer, who was allowing lime to run into one of the worst polluted streams in the State, the manufacturer placed on the stand a skilled chemist who testified that the amount of effluent going from the manufacturer into the stream, would soon be so neutralized by the volume of water that it would be no stronger than the lime water with which a mother mixes the milk for her child. On this testimony the manufacturer was acquitted, and the Department is now co-operating with the Department of Health in a campaign in which every manufacturer, from the source to the mouth of the stream, will be notified that he must conform to the law within a certain date or prosecution will be brought against them all.

This is the plan that the Department intends to pursue in the future. One water shed will be taken and every manufacturer situated on that shed will be compelled to abate the nuisance, or as a last resort, the Department will sue out an injunction. This latter is a drastic method and one to be adopted only when it becomes absolutely necessary to force the offender to terms. The Department is sure that it is backed up by public sentiment in this course, because it is plainly evident that the people of the Commonwealth will no longer stand for the defilement of the waters, which keeps them barren of fish and renders them useless for domestic purposes.

The Supreme Courts of New York and Indiana have decided in a pollution case that the persons on a stream are entitled to the water as pure as when it left the source. Nature knows no such thing as waste and modern science has shown that any waste flowing from a manufacturing establishment is a distinct economical loss. As long as there was only one manufactory on the stream the manufacturer did not feel any economical loss himself because the water was polluted, but when the man above him began to run in refuse in such quantities that he was compelled to put in a purification plant to get his water clear, he began to realize what pollution means, and the Department finds more manufacturers who are ready to co-operate with it than it does those who are willing to make a fight.

DISCUSSION

MR. NESLEY, of New York: I wish to ask Commissioner Buller how the cost of the bass gathered in the field would compare with that of those raised in the hatchery ponds, and my reason for asking is that I have always believed that spawning bass gathered in the field would not cost more than one-tenth of those reared for the purpose. The work of gathering would extend only over a couple of weeks, while otherwise the salaries of hatchery employees must be paid for the whole year.

Mr. Buller: I cannot answer the question as the work was done by our regular trained employees who are employed the whole year through and their expenses would be the same whether they worked in the field or in the hatchery.

President: I would suggest to Mr. Nesley that if everybody were to work in that way the natural crop would become exhausted.

Mr. Woods, of Missouri: What is the cause of the pollution of the water of which Commissioner Buller complains?

President: Two or three years ago I had occasion to address this Society on the pollution of streams. At that time the streams in western and especially southwestern Pennsylvania were foul with the yellow sulphurous offal that comes from exhausted coal mines, and there were no fish, frogs, insects or other living things in these streams.

Mr. Buller: I recently made two trips through western and southwestern Pennsylvania to make observations on the pollution of streams by coal mines and large manufacturing plants. Not even a typhoid germ will live in those waters. The pollution comes from various manufactories, paper mills, etc., and coal mines. One paper mill that I particularly studied spends thousands of dollars weekly to purify the water for a certain process, then runs its own refuse into the stream for the next man below.

President: The Chair will take occasion to say to Mr. Woods that the causes of pollution are numerous. There are wastes from all sorts of manufactories and others due to dense population. There are rivers here in New England that are a dangerous asset. They are so black that nothing will live in them, and the same is true of those of eastern New Jersey. The Ohio River is very nearly an open sewer below Pittsburgh, and carries disease to the towns below. The task of cleaning up many rivers in the United States is a herculean one.

Mr. Buller: In this campaign which the Department of Health and the Department of Fisheries are making in Pennsylvania, ninety-five per cent. of the manufacturers are in full accord with us and are spending thousands of dollars with the result that they have eliminated much of the pollution, but it is a stupendous task. The difficulty is to find a way to take care of the large quantities of polluting material.

President: Most of you are aware that a great deal of our effort in fish culture in this country is lost on account of the pollution of the water. We are pouring young fish into streams, which, while pure at their head-waters, are impure and unfit for fish life farther down. It is evident that we are approaching the point where the pollution nuisance will be intolerable and we will have to clean up as they have done in many parts of Europe. Factory wastes can be made into by-products, and sewage can be converted into fertilizer for the soil. This nuisance can be abated whenever the courts make it too expensive for manufacturers to continue as they are now doing.

Mr. Thomas, of Virginia: In western Pennsylvania there are forty thousand coke ovens which have allowed all the gas to go to waste. But at Bethany the gas is made use of to run their own furnaces and to furnish the city with gas at the same time, and not one thing is allowed to go to waste. That is a sample of what can be done by scientific methods.

Mr. Rider, of Minnesota: Will deposits of corncobs from canning factories pollute the water to the detriment of the fish?

Mr. Evans, of Pennsylvania: In a recent canning factory fire in my State a great many cans of stuff were exploded by the heat. The contents fermented in the stream and killed the fish. Corncobs would sour in a similar manner and be a menace to the fish.

President: I happen to be the author of a somewhat lengthy paper on the pollution of streams. If any member desires to go into the subject I will be glad to mail him a copy on receipt of his address.

CONDITIONS REGULATING THE GROWTH OF THE CLAM (*Mya Arenaria*).

BY DAVID L. BELDING,
Biologist of the Massachusetts Department of Fisheries and Game.

It is with some hesitation that I submit for your consideration an old, though interesting, subject; but I desire to approach it from a viewpoint slightly different from that taken by previous writers. I desire briefly to outline the more important natural conditions which regulate the growth of lamellibranch mollusks, using the soft clam (*Mya arenaria*) as an illustration. In the future the tidal flats of Massachusetts will undoubtedly be covered with numerous clam farms. Therefore, from a practical standpoint, a knowledge of the conditions which influence clam growth will be of value to the culturist in the selection and development of his grant.

In the tidal waters clams are present in abundance on some flats, in scattering quantities on others and in many sections entirely absent. The reason is that certain definite conditions are essential for a favorable environment. There is no more convincing illustration of the influence of environment upon the life of a clam than the effects of the surroundings upon the rate of growth. Chief among these natural forces may be enumerated current, tide, soil, depth and salinity of the water, so closely interwoven that their separate action cannot always be clearly demonstrated. Any discussion of these conditions, which form a favorable or unfavorable environment, involves their separate treatment; but it should be understood that there are few, if any, instances where the pure uncomplicated action of a single natural condition can be obtained. These factors naturally fall into three main groups: (1) the circulation of the water or the current; (2) the condition of the water; and (3) the character of the soil.

Current.—The most important factor in clam growth is a good current, not necessarily an exceedingly swift flow, but rather a fair circulation of water. The varied services of the current render it of special importance to the culturist in the selection of a grant since the productive capacity of clam flat depends almost wholly upon the circulation of water. It is a well known fact that the growth of the clam is more rapid where the water is in constant motion than in still water, and it has been commonly considered that this difference is due to the increased amount of food, the clam in the current receiving the greater food supply. But rapid growth in a good circulation of water is a more complex problem than a simple increase in the available food supply, and it is the main object of this paper to show that our previous explanation of the effect of current on growth is only partially correct. Current affects the life and growth of the clam in many ways, but chiefly by regulating (1) the food supply, (2) the amount of available oxygen, (3) the feeding habits, (4) the secretion of lime salts and (5) the sanitary conditions.

Food Carrier.—An important work of the current is that of carrying food. The clam obtains its nourishment from the microscopic forms, which are generally distributed throughout all waters, although different localities vary in abundance according to the conditions favorable for their reproduction. The growth of the clam, as with lower animals, is directly proportional to the amount of food consumed, and the animal situated in a current naturally receives a greater food supply than one in still water. For all practical purposes current means food, and within certain limits the increase in current indicates the increase in quantity of available food, thus furnishing an approximate index of growth. Since the clam is a stationary animal with a limited feeding range, it is obvious that a maximum point of food assimilation can be obtained, when the clam will be unable to take in any more food from a swifter current. For this reason the term current, as used here, implies only a good circulation of water and not an exceedingly swift flow.

Oxygen Bearer.—The relation between the amount of food, the supply of oxygen and the feeding of the clam in a current is comparatively intricate and the exact proportion that each factor contributes to the increase in growth, as far as figures are concerned, is somewhat problematical. Oxygen, the most important, affects growth in two ways, first by increasing the metabolism of the body, and second by stimulating the feeding activities of the clam, but so closely are these actions connected that it is impossible to determine their relative values. Oxygen is needed for life and with an increase in the amount of available oxygen the bodily functions are performed more readily. The usual supposition that the effect of current upon clam growth was entirely due to the actual increase in food forms was disproved in 1907 by an experiment, which demonstrated that the increase in the food supply was only a partial explanation. The results indicated that the beneficial action of the current consisted rather in increasing the clam's power of assimilating food. By the following method an approximate idea of the actual increase in the food supply as compared with the total increase in growth for hard clams in still water and in a current was obtained.

At Monomoy Point, Massachusetts, the rate of growth had been followed for several years for two experimental beds of hard clams, the one in still water showing a slow growth, the other with a good circulation of water having a much greater increase. To test the relative difference in the amount of food forms at a definite point on these beds small nets of silk bolting cloth, No. 11, two inches in diameter and four inches long, were so arranged that they would rotate on an iron rod after the manner of weathervanes. When in position the nets remained extended in the water and on the slightest motion would swing on a pivot, thus always presenting the opening of the net to the current. One net was placed over the bed in still water, the other, identical in every respect, was situated over the bed in the current for the same length of time. After having been down a certain number of hours they were taken up, the contents of the nets washed into a small quantity of water, and the food forms counted by means of the Rafter cell, the approximate number of standard units per cubic centimeter in each case being determined. Two parallel sets were run at three different times, ranging from eight to eighteen hours each. The total number of standard units per cubic centimeter for the current was 2,188,800, for the still water 1,612,800, giving a gain of 35.7% for the current. The annual growth of the hard clams in the current showed a gain of 24.5 mm. or 612% by volume as compared with a gain in the still water of 13.62 mm. or 241% which was 2.6 times as much. These figures are at best only approximate but are sufficient to show that there is a great discrepancy between the actual increase in the food supply and the rate of growth. Numerous errors are possible in this test; in the placing of the nets, in the technique of counting, and by comparing the yearly growth with the food supply for a short period; but the vast difference is striking, since it is apparent that the 35.7% gain in food cannot account for the great difference in growth, and we are justified in concluding that other factors, one of which is an increased supply of oxygen, are even more important.

Observations upon clams in aquaria in still or even stagnant water show that they feed but a small portion of the time, lying with their siphons partly extended in a semi-dormant condition. In these cases, if the water is slightly agitated by blowing upon the surface, the clams stretch out their siphons and begin to feed actively, showing the stimulation from the circulation of the water. Practically no growth has been obtained from clams in still water aquaria, in spite of the fact that they have been well supplied with food forms. A possible explanation is that current serves in some way to stimulate the feeding of the clam and in this manner increases its powers of assimilation.

Lime Furnisher.—Current also furnishes the clam with the lime salts in solution in the water, which are utilized in forming the shell, a process as essential to growth as the assimilation of food. The lime salts are obtained from the water,—since it has been shown that clams will grow out of sand,—and are transformed into a suitable form for shell secretion in the body of the clam. The assimilation of the calcareous salts depends upon the temperature, the activity of the animal, the quantity in solution and the current.

Sanitary Agent.—The work of the current as a sanitary agent consists in removing decomposing matter, silt and decaying organic material, thus preventing the spread of disease and the destruction of thickly planted beds.

Water.—The composition of the water, organic and inorganic, soluble and insoluble, and its physical characteristics influence the growth of the clam. The soluble constituents, chiefly the nitrogenous salts upon which the miscroscopic food forms subsist and the lime salts for the shell, indirectly affect the rate of development. The insoluble material, such as silt and sediment of various kinds, tend to interfere with the feeding of the clam, which starves itself by mechanically throwing off both food and silt from its gills. The insoluble food forms, on the other hand, are of value for the nourishment of the clam. Likewise the physical characteristics of the water, such as salinity, temperature, depth and tide may influence the existence of the clam.

Salinity.—The clam will grow in nearly all degrees of salinity, even as great a range as from 1.004 to 1.024. It can be transplanted from waters of low salinity to high or vice-versa without apparent harm, an interesting fact for the culturist, and in this respect is in striking contrast to the oyster, which is affected by the slightest change in salinity.

Temperature.—Temperature is the great controlling factor which regulates the growth, habits and existence of marine animals, differentiating the fauna and flora of one region from another. With the clam, temperature explains the faster summer and the slower winter growth, the warm water stimulating the assimilation of food and the secretion of the shell while the cold water causes the animal to become sluggish.

Depth.—Little difference has been noticed in the growth of clams suspended in sand boxes at various depths, and since the habitat of the clam is between the tide lines the question of depth is of little importance. In enclosed bays the deeper layers of water do not always have as good a circulation as the shallow waters, which are disturbed by wind and wave action; but in the tidal rivers the deeper waters have the stronger current.

Tide.—Although the natural home of the clam is between the tide lines, submerged beds are occasionally found below extreme low water mark and numerous experiments in Rhode Island and Massachusetts have demonstrated that submerged clams grow faster owing to a longer feeding period. A series of beds extending from high to low water mark shows a gradual increase in growth as low water mark is approached. Assuming that the clam feeds continually when under water, an increased daily exposure materially lessens the amount of food consumed, an assumption that is open to the criticism that the clam may not feed continually and that the lower beds have a better circulation of water. The latter objection has been eliminated by parallel experiments where the only difference was the exposure.

Soil.—Soil is a less important factor in clam growth than is commonly supposed and affects the growth in two ways, indirectly by affecting the quantity of food, and directly by affording a resting place. Soils vary in their capacity as breeding grounds for the production of the microscopic food forms, which multiply upon the surface of certain flats. The direct action of the soil is largely mechanical and the actual character affects the shape, flavor and growth of the clam. Dr. J. L. Kellogg states that a tenacious sand (fine sand with a little cementing mud) furnishes the best medium for the clam, both from the standpoint of growth and easy digging. Nevertheless clams grow in nearly every kind of soil provided that it is not shifting sand or soft mud. Even in such cases exceptions are frequently noticed, clams often being present where there is moderate shifting, while large clams are occasionally found in extremely soft mud. To insure the best growth, the soil should be free from decaying organic matter, it should be of firm consistency, not readily affected by storms or currents and free from substances which might injure the clam. Any soil possessing these qualifications, no matter its exact composition, is suitable for clam growth.

Soils may be grouped into three main classes, sand, mud and gravel, with many intervening combinations. Flats of fine sand, usually swept by a current, furnish the best appearing clams with a smooth white shell in marked contrast to the rough and deformed gravel clam. Mud flats are usually situated where there is little current or where streams deposit material from the land and in most instances produce a slower growing clam. Gravel flats, though less extensive, nearly always contain clams which by reason of their environment have a heavy protecting shell.

Unproductive Soils.—Tidal clam flats are of two classes, productive and unproductive. Usually the boundary line is sharply marked, but at times no noticeable difference can be seen except that one flat produces clams while the other does not. The unproductive flats can be further grouped into permanent and temporary, the latter including the flats where clams will grow if planted, but which either do not receive the set, or owing to changed natural conditions are temporarily unproductive. This type of flat is especially adapted for clam culture. The permanent barren flats comprise soils that can never be reclaimed, soils that can only be utilized after considerable expense, and soils that can be made productive at a slight cost.

There are several classes of unproductive soils. (1) Soft mud smothers the small clams, prevents the set by reason of its slimy surface and, by the fine particles of silt, interferes with the mechanical feeding of the clam. (2) Eel-grass prevents the circulation of water, collects slime and silt and furnishes a mass of decaying material injurious to the clam. (3) Mussels ruin a clam flat by collecting soft mud, covering the clams and utilizing the same food. (4) Organic material from various sources in a soil corrodes the shell and interferes with the shell-forming properties of the mantle. In certain river flats manufacturing wastes, chiefly of the petroleum group, render the clams unpalatable, the surface unfit for set, and, in extreme cases, may destroy the adult clams. (5) Shifting sand does not favor the growth of clams, although adult clams will stand a surprising amount of shifting. Flats with a slightly rippled surface are barren because the young clams cannot get a permanent foothold, but such soils respond to cultivation provided that the shifting is not too severe and that large seed clams are planted, although the culturist runs the risk of storms and swift tides destroying his crop.

Practical Application.—The points brought out in this paper are of practical application in two ways, to the clam culturist in selecting the location of his grant and as a basis for methods of reclaiming a large area of barren flats. The only way the tidal flats of Massachusetts and other states can be made truly productive is by a system of individual leases under which every fisherman can have a salt water farm for the production of shellfish.

In selecting his grant the prospective culturist should bear in mind that the current is the most important guide, since the productive capacity of a clam flat depends chiefly upon the circulation of water, and he can follow the general rule that as long as the flow of water does not harm the clam in other ways the swifter current gives the faster growth. Yet he should not forget that there may be disadvantages as well as advantages, excessive action causing the shifting of the flat, destruction of clams and the prevention of set, and that no hard and fast rule can be stated.

Thousands of acres of barren flats may be reclaimed by such means as artificially directing the tidal currents, seeding with small clams, covering soft soils with sand or gravel, draining certain areas, and forming a tenacious surface by planting thatch on smooth current-swept flats. Each flat represents an individual problem and special methods must be adapted for each case.

Summary.—In this paper I have endeavored to bring out the following points: (1) The environment of a clam is the result of many complex forces, some of which I have enumerated, so interwoven in their action that it is difficult to definitely determine their separate influences. (2) The existence of the clam depends essentially upon three groups of conditions, the current, the water and the soil, while the *rate of growth* from a practical standpoint depends chiefly upon the *current.* (3) A knowledge of the relative value of these factors is of importance to the clam culturist. (4) The former prevailing explanation that current achieves its result by merely increasing the amount of available food is entirely inadequate. The actual increase in the food forms by no means accounts for the much greater growth, which is evidently due to the increased powers of assimilation of the clam either directly by the stimulation of the current or indirectly by the supply of oxygen.

DISCUSSION

Mr. Lydell, of Michigan: Is it possible for fresh water clams to get into a pond unless the clams themselves are carried there? We have a pond that was dug in the soil eight or nine years ago and it is now filled with the fresh water mussels.

President: The larvæ of fresh water clams are temporary parasites on certain kinds of fishes. These larvæ attach themselves to the gills and fins of these fishes until they reach a certain stage of development. Your fishes probably transferred the clams to the pond in this stage, after which they dropped off and grew to maturity.*

Prof. Dyche, of Kansas: What is the geographical distribution of this species of salt-water clam?

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*See "Studies on the Reproduction and Artificial Propagation of Fresh-water Mussels," by George Lefevre and Winnerton C. Curtis, in Bulletin of the Bureau of Fisheries, Vol. XXX, 1910, pages 105-201, plates 6-17.—*Editor.*

Mr. Belding: I do not know the exact range of the species. It runs northward to Canada and as far south as Carolina. It is abundant in Maine, Massachusetts and other New England States.

President: The introduction of the Eastern soft-shelled clam to the Pacific coast was one of the early moves of the Fish Commission and met with great success. I happened to be living in California after the clam got fairly established. If you were to go along the shores of San Pueblo Bay today at low tide you would find many clam diggers at work. This clam is highly appreciated in the San Francisco markets. We cannot get along without the clam on this coast, and we shall eventually adopt means for cultivating it.

THE SEA MUSSEL INDUSTRY.

By Irving A. Field,
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Three years ago at the New York meeting of this Society I presented a paper which dealt with the food properties and commercial value of the sea mussel. Attention was called to the fact that in Europe there was a large and ready market for this shellfish, while in America New York City was the only place where any sale could be found for them. In the present paper it is my purpose to outline the development of the sea mussel industry, to show what is being done in Europe, what we are doing in the United States and what we ought to be doing in the way of utilizing this valuable but hitherto almost neglected mollusk.

The origin of mussel culture was in the Bay of Aiguillon on the west coast of France in the year 1235. The inventor of the system was Patrick Walton, an Irish sailor, who was shipwrecked on that coast and rescued as the sole survivor of his ill-fated vessel. He was kindly received by the native fishermen and invited to make his home with them. In return for their cordial hospitality he was able to give them a rich and lasting reward. Previous to his arrival the fishermen of that region had made poor success at earning a livelihood, but Walton, who was a most ingenious fellow, was quick to perceive the wealth which might be obtained from the neighboring great swamp of mud. Starting out to make a living by capturing birds in a net which was suspended between stakes driven into the mud of the swamp, he soon observed that young mussels were attaching themselves in enormous numbers to the wooden supports. He noticed that they grew with great rapidity and that they were of superior quality and flavor to those which grew on the mud. The conclusion was quickly reached that mussels could be profitably raised on wooden frames, and Walton promptly put this idea into practice with a success that has brought a lasting blessing to the several villages which border the Bay of Aiguillon.

The system of cultivation which was finally devised by Walton consists of a wicker work constructed on rows of stakes arranged in the form of a V with its apex pointing toward the open sea or direction from which the strong waves and tide come. This arrangement is to protect the structure from the destructive action of the wind, waves and ice. The stakes are trunks of trees 6 to 12 inches in diameter and from 10 to 15 feet in length. They are placed from 2 to 3 feet apart and driven into the mud for about half their length. Then branches of osier or chestnut are twisted back and forth between the posts in horizontal rows about 20 inches apart from the top to within a foot of the bottom. If placed closer together than this they are apt to accumulate mud and cause deposition of silt. Walton left an opening 3 to 4 feet wide at the apex of the two wings where traps were placed to catch the fish which went out with the tide, thus making the structure serve a double purpose.

The length of the wings depends on the size of the area covered by the tide, which is about one-fourth of the distance between the extreme limits of high and low water. At the present time in the Bay of Aiguillon they are about 250 yards in length but are no longer arranged in the historic V form. They are now placed at right angles to the shore in parallel rows, about 30 yards apart.

The buchots are arranged in several series from the deep to shallow water, but in general three groups are recognized according to the function they perform. One set consists of large, solitary stakes placed about 1 foot apart out in deep water where they are uncovered only by the lowest tides. These serve for the collection of spat and are known as the low crawls.

The second series of buchots is placed half way between tide marks and serves for the growth and fattening of the mussels. Several rows of crawls, each with a separate name, may enter into this series. The general term applied to members of this group is false crawls.

The third series of buchots is situated in the upper limits between tide marks where they are exposed several hours each day during low water. They are known as the high crawls and serve to inure the mussels to exposure and consequently make them keep longer and fresher than those from the lower rows.

The method of working the buchots is to collect the seed mussels and transfer them successively from the lower to the higher crawls at the proper times. Spat is liberated in the Bay of Aiguillon during February and March and is caught on the low crawls which are situated in an ideal location for the preservation and growth of the young shellfish since they are rarely exposed to the air. When the set of spat first appears the young mollusks are smaller than a seed of flax and are called *naissan.* The young mussels grow rapidly so that by July they reach the size of an ordinary bean. In this condition they are termed *renouvelain.* They are now ready for transplanting.

The seed mussels are scraped from the low crawls by means of a hook set in a handle and are placed in a characteristic type of basket. The mussels are then loaded into a special form of mud boat or "acon" which is also an invention of Walton's. The boat is made of a plank about 10 feet long by 2½ feet wide bent up in front to form the bottom and prow. The sides and stern are each composed of straight boards about 1½ feet wide. The boat is further reinforced by a shelf in the stern and a narrow thwart close to the bow. A board may extend across the middle to serve for a seat or it may be replaced by a wooden stool. A paddle and a short pole complete the equipment. When the boatman wishes to travel over the mud flats he faces the prow of the boat, puts his left knee on the bottom and thrusting his right leg, encased in a long sea boot, over the side of the boat, pushes it along. By this means he is able to glide over the mud at a rapid rate. When shallow water is reached navigation is accomplished by means of the pole and when deeper water is encountered the paddle is used. The seed mussels which are collected from the low crawls are transported by this means to the false crawls or next higher row of buchots where parcels of them are attached to the wicker work by means of old netting. The shellfish immediately begin to attach themselves to the wooden structures by their byssal threads, so that by the time the netting has rotted or washed away, they are firmly united to the crawls.

The rate of growth in this position is very rapid and in a few months they become so crowded as to almost hide the frames. It then becomes necessary to transplant them again, this time to the next series of crawls lying nearer the shore. The mussels are attached by the same method previously employed but are not fastened so securely since they are able at this stage to attach themselves to the buchots much more quickly. After one year's treatment on the crawls the mussels reach a length of 1¾ to 2 inches, which is marketable size.

The net returns from an investment in a series of buchots is approximately 11½%. To quote from Coste, the production and value of cultivated mussels in the Bay of Aiguillon is as follows:

> A bouchot well stocked furnishes generally, according to the length of its wings, from 400 to 500 loads of mussels; that is to say, about one load per meter. The load is 150 kilograms, and sells for 5 francs. One bouchot, therefore, produces a crop weighing from 60,000 to 75,000 kilograms, and valued at 2,000 to 2,500 francs; from which it follows that the crop from all of the bouchots united would weigh about 30,000,000 to 37,000,000 kilograms, which, at the figures already given, would be worth about 1,000,000 to 1,200,000 francs. These figures and the abundant crops from which they result, give an idea of the food supplies and of the great benefits that may be derived from a similar industry, if, instead of being confined to only one portion of the Bay of Aiguillon it should be extended to the whole of it and carry it from the locality where it originated to all the coasts and salt water lakes where it could be successfully carried on. In the meantime the prosperity which it secured to the three communes of which it has become the patrimony will remain as an end worthy of effort; for, thanks to the precious invention of Walton, wealth has succeeded poverty, and since the industry has been developed here no healthy man is poor. Those whose infirmities condemn them to idleness are cared for in a most generous and delicate manner by the others.

Other methods are also employed in France for the cultivation of mussels. In some places they are raised in claires or artificial reservoirs the same as oysters, especially in places where the abundance of mud and silt renders oyster culture difficult.

A modification of the buchot method of myticulture is employed in a part of the Lamotte Canal near Marseilles. The canal is one of the branches which puts the sea in connection with Berre Lake and is traversed back and forth continuously with the tidal waters which contain great quantities of diatoms and infusoria making it an especially rich place for the cultivation of mussels. Because of the slight rise and fall of the tide in this stream it is impossible to use the bouchot system of culture. In place of it claies or movable wooden frames are placed vertically between grooved stakes on which they can rise and fall by means of a floating axis. The grooved stakes are mounted with a cross tree bearing a ring on the under side. The frame is surmounted with a hook so that it can be raised from the water and hung on the ring of the cross tree above. With this device the mussel culturist can at will, gather, replenish, wash or do any necessary work and when through return the frame to the water.

The capacity of one of these claies is about 10,000 mussels weighing from 660 to 880 pounds. The young mussels are collected on the shores of Berre Lake and placed on the claies by the same method employed for fixing seed mussels to the buchots. When of sufficient size they are marketed without any further transplanting.

Still another means for collecting spat and rearing mussels is by means of the raft collector. It consists of a raft from which hang planks or frames in a vertical position. It is anchored in a region where mussels are spawning and when covered with spat is towed to a breeding basin where the rearing can take place without any further care than to see that no mud accumulates on the frames. The chief objection to this contrivance is that the planks or frames decay rapidly, often causing an entire loss of the harvest.

Myticulture is also practiced in Italy, especially in the vicinity of Taranto, where mussels are raised to supply the southern markets of the peninsula as far north as Rome. Here the shellfish are cultivated on ropes made from rushes or "alfa" suspended in the water from stakes which are placed from 20 to 30 feet apart depending on the depth of the water. The ropes are hung over the mussel beds close to the shellfish in order to catch the free swimming young. Six months after a set of spat has occured the ropes are taken up and all the shellfish on them which have attained the size of an almond are removed. The smaller ones are left to grow until the following season when they will have attained sufficient size for food purposes. The larger mussels selected are interlaced, either singly or in bunches, into ropes which are then suspended vertically from a main rope extending between two stakes planted out in deep water. Parks are also utilized in the culture of mussels by this means, some of them extending 2600 to 2925 feet into the sea. The yearly yield of such a park is 40,000 to 50,000 pounds worth from $880 to $1,100.

In Germany the Bay of Kiel contains extensive areas where mussels are cultivated. The method employed at this place is to drive stakes into the bottom and leave them there for a period of from 3 to 5 years, during which time they become covered with mussels of marketable size. They are then taken up, stripped of the shellfish and replaced by others. About 1,000 stakes are planted annually in this locality from which the yield of mussels amounts to about 800 tons.

The systems of myticulture so far mentioned are adapted for regions where the bottom is composed of mud too soft to support a bed of mussels and where there is considerable rise and fall of tide over large areas. Where the bottom is hard or covered with only a thin layer of mud, and silt is not being deposited rapidly, a much more economical method of cultivation is merely to transplant the mussels from crowded situations to more extensive areas where food is abundant. It is in this manner that mussels are grown for the market in England and for that reason is often spoken of as the British method to distinguish it from the French or buchot method. The practice is to collect young mussels from salt water and sow them on artificial beds in favorable localities. The best regions for planting are estuarine flats where there is plenty of sand and gravel covered with mud rich in diatoms, infusoria and spores of algæ. Care should be taken to avoid planting the beds where they will be uncovered at low tide or subject to the ill effects of floods, gales, shifting sands or frost.

The advantages of the bed system are being recognized in other countries. It is recommended in Belgium, Scotland and Norway. Some of the progressive fishermen in this country have recently put the transplanting method into practice with great success in certain regions of Long Island Sound. In one case a fisherman was paid by an oysterman to remove great quantities of mussels which were growing on and about his oyster beds. The fisherman carefully planted them at the mouth of Oyster Bay and three years later dredged them up by the hundreds of barrels which he sold in New York at a net profit of $.75 per barrel. For two months he was able to market 100 barrels daily which will indicate the income he was able to derive from this business. It is needless to say that this man is still cultivating mussels.

The yield from a crop of mussels is something enormous and difficult to comprehend. In agriculture corn is considered one of the most prolific and valuable of farm products, producing in maximum 246 bushels to the acre. If marketed at $.75 per bushel the farmer realizes $184.50. However, when compared with a crop of mussels this yield appears small. Estimates for the English beds allow an average yearly production of 108 tons per acre, valued at $262.00. Mr. Geo. A. Carman reports that the artificially planted mussel beds in the vicinity of New York produce from 4,000 to 6,000 bushels per acre which at the market price of $.40 per bushel amounts to a value of $1,600 to $2,400. Allowing 3 years for the growth of these beds it leaves an annual average income of from $500 to $800 per acre. Furthermore, the time and labor required to plant and care for an acre of mussels is almost nothing compared with that expended by the agriculturist in raising his grain.

The importance of the mussel fishery in Europe ranks second only to that of the oyster among the shellfish industries. The statistics have been difficult to secure with any degree of completeness but what few official reports have been obtained show that the total value aggregates close to a million dollars which is distributed among the countries as follows:

Country	Quantity: Pounds.	Value: Dollars.
France	90,044,010	$559,276
Belgium	56,129,356	255,133
Netherlands	3,737,481	23,300
Ireland		15,510
Portugal		12,275
England	3,519,860	15,125
Germany	370,100	2,375
Total		$882,994

Dr. Ray Lancaster in his article on the mussel in the Encyclopedia Britannica states that in 1873 the mussels exported from Antwerp to Paris to be used for food were valued at $1,400,000. If this production still continues the total yearly value of the mussel fishery for Belgium and France alone equals nearly $2,000,000. This indicates how the mussel is appreciated in Europe.

In the United States, although exceedingly abundant, the value of the sea mussel as a food product remains almost unknown. The quantity and value of sea mussels marketed in the United States for food, bait and fertilizer in 1908 was as follows:

State.	Quantity: Pounds.	Value: Dollars.
New York	8,175,000	$8,200
California	68,000	1,600
New Jersey	287,000	1,400
Connecticut	7,200	200
Rhode Island	3,500	100
Massachusetts	1,100	100
Total	8,541,800	$11,600

To look at these figures, then at the extensive mussel beds and then at the facts concerning the chemical composition, nutritive value and low cost of this shellfish will convince any one that we have been neglecting one of the great and valuable resources of the nation.

A glance at the following tables which are based on data collected from unprejudiced sources will be sufficient to show the great superiority of the sea mussel as a food over the other shellfish commonly sold on the market.

COMPARATIVE COMPOSITION AND FUEL VALUE OF CERTAIN SHELLFISH.

Species	Refuse	Water	Protein N x 6.25	Fat	Carbo-hydrate	Ash	Total nutrients	Fuel value per pound
	P. ct	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*P. ct*	*Calories*
Sea Mussels	46.7	44.9	4.6	0.6	2.2	1.0	8.4	150
Lobsters	61.7	30.7	5.9	0.7	0.2	0.8	7.6	141
Long Clams	41.9	49.9	5.0	0.6	1.1	1.5	8.2	136
Round Clams	67.5	28.0	2.1	0.1	1.4	0.9	4.0	68
Oysters	81.4	16.1	1.2	0.2	0.7	0.4	2.5	41

COMPARATIVE COST OF PROTEIN AND ENERGY FURNISHED BY SEA MUSSELS AND OTHER SHELLFISH.

Species	Price per pound	Cost 1 lb. of protein	Cost of 1000 calories of energy	Amounts for 10 cents		
				Total wt. of shellfish	Protein	Energy
				lbs.	*lbs.*	*Calories*
Sea Mussels	$0.01	$0.22	$0.07	10.00	.806	1500
Long Clams	.04	0.88	0.29	2.50	.125	340
Oysters	.03	2.51	0.68	3.33	.040	147
Round Clams	.05	2.38	0.75	2.00	.042	136
Lobsters	.18	3.05	1.29	0.556	.033	77

It is evident from the facts recorded in the above table that from the standpoint of economy the sea mussel surpasses all other shellfish foods by a wide margin. The same amount of money spent for mussels as for long clams will purchase more than four times as much energy. A similar comparison with oysters shows that the amount of energy supplied by mussels is ten times as great while with lobsters it is nearly twenty times as much. Not only is this shellfish an abundant and economical food, but it is tender, of fine flavor, and it has been shown to be as digestible as steamed beef. A French writer has expressed its food qualities by the following ratio: "Mussels are to oysters as potatoes are to truffles." In other words mussels are a substantial, economical food, not a luxury.

The conclusion to be drawn from all the evidence obtainable is that the sea mussel is not only as palatable as the oyster, but is the cheapest and most nutritious shellfish which can be placed on the market.

Efforts to induce the American people to eat mussels are now being made by several firms which are meeting with varying success. A packing company in Maine put samples of the canned and pickled shellfish on sale in a number of the New England cities, but although attractively put up in glass jars they were undersized, of poor quality, and had evidently been sterilized at too high temperature, which resulted in a decomposition of the protein into compounds which gave the product a disagreeable flavor. The project naturally met with poor success and no further attempt to put goods on the market was made during the past year.

One of our largest oyster companies has also taken an interest in the commercial possibilities of this mollusk. They have put out splendid samples of it in the form of *pickled mussels, deviled mussels* and *mussel cocktail* such as you see here on exhibition. The materials used are of finest quality and they are put up in a most attractive manner. If the goods taste as well as they look I predict a bright future for them. The president of the concern, however, speaks of them in a pessimistic tone. The company has been at considerable expense to get out these samples, but the result has been nothing more than favorable reports as to their quality and flavor; no orders of any importance have been received. The people do not like their color and general appearance, and show a general prejudice against them without being able to give any reason for it. It will require a campaign of education to teach the public what it is missing by refusing to utilize this vast source of food supply.

The most encouraging news has been received from a Brooklyn dealer who during the past year has sold 50,000 bushels in either the fresh or pickled form. This is equivalent to double the value of the salt water mussel industry reported for the entire nation in 1908. His report further states that the business is growing and that a market is beginning to develop for them inland. His products are of superb quality and flavor, samples of which you will find here for examination. Other concerns with whom I have not been able to get in touch are marketing mussels in one form or another, but chiefly in the fresh condition, or pickled in vinegar and spices. Quantities of the shellfish are usually to be found on sale in Fulton Market. The demand for mussels in New York reached such a stage this past year that one Brooklyn firm complained it could not get its needed supply for pickling purposes.

Prejudice is a slow barrier to overcome, but the outlook is favorable for a gradual development of a sea mussel industry which will not stop until it has reached the same plane it now occupies in Europe, second only to that of the oyster.

DISCUSSION

PROF. PRINCE, Commissioner of Fisheries of Canada: Dr. Field has expressed surprise that the mussel is not more utilized for food. It is a matter of great surprise that this delicious mussel is not in greater demand. I have eaten very few mussels since coming to this continent, although I much prefer them to oysters or other shell-fish. They can be prepared in various ways for which the oyster is not suitable. As soon as people become accustomed to eat the mussel I believe it will take the first place as an edible shellfish. In London alone about fifty or sixty thousand tons are sold annually for food.

Apart from this, the mussel is the most important bait used by the fisherman. The Scotch fishermen use forty or fifty thousand tons per year for bait, and it is one of the most interesting spectacles for a traveler at a fishing village to see the dexterity with which the fisher-wives bait the lines with mussels.

I am astonished that our fishermen do not use mussels more frequently instead of clams and various fish. The mussels are such an attractive bait, especially for cod, haddock and such fish, that the development of this industry is well worthy our efforts to promote.

Many years ago I was Secretary of the Mussel Commission of the British Islands and visited various mussel beds on the continent of Europe, and saw something of the methods of cultivation. The British coast is much exposed and artificial beds are carried away by storms, so we had to resort to transferring the young mussels to other localities where they could find food to grow into marketable size. The bed system and methods of artificial culture are a little too expensive on this side and in Britain. There is a lot of handling, and labor is expensive. I wish Dr. Field would explain why they still continue it in France and make it pay.

Dr. I. A. Field: The reason they can carry on the bed system in France is because both labor and material are particularly cheap in that region. Furthermore the mussels grow large and at a phenomenal rate and bring the best prices, I think, of any mussels growing along that coast.

President: I find my neighbors on the Connecticut coast do not use them much. There is a fine bed near me on the Sound, but it is entirely neglected except by my own family. During a voyage of the Albatross we found the Indians about the Straits of Magellan living chiefly on the large mussel, *Mytilus chilensis,* which average five or six inches. Our whole ship's company of eighty persons feasted on these wonderful mussels which were eaten steamed.

Prof. Ward, of Illinois: Is the shell of these salt-water mussels utilized for commercial purposes?

Dr. I. A. Field: I think there is a commercial use for it in the form of chicken feed. In addition to the lime it contains about 8% of albuminous material in the adult (16% in the year-old shell). If that albuminoid material can be digested by hens there is no reason why it cannot be converted into eggs.

Mr. Lydell, of Michigan: Has anyone tried this mussel, by grinding it up, as food for young bass or any other fish we are attempting to raise? We have been experimenting with the meat of the fresh water mussel from the button factories. We have been very successful so far with young bass, and I hope to report upon the matter in another year. We have also fed them whole to the large bass which appear to be very fond of them.

President: The Chair can answer Mr. Lydell's question in part. There is no doubt that nearly all kinds of fishes are fond of mussels. At the New York Aquarium the salt water mussel has been used along with other molluscs. Some fishes are especially fond of crushing the shells of the smaller ones.

ALEWIFE FISHERY OF MASSACHUSETTS

By G. W. Field,
State Commissioner of Fisheries and Game, Boston, Mass.

In Massachusetts the decline of the alewife (*Pomolobus pseudoharengus*) or "branch or river herring" fishery has for several years demanded the attention of the Department of Fisheries and Game.

During the past two years, a biological survey of the various streams in the State has been undertaken with the view of determining the present conditions, and what methods could promise the successful re-establishment of a fishery directly valuable to the shore towns, but indirectly of still greater value to the public. It is upon the result of this work that I desire to speak concerning the past and present conditions in the alewife fishery of Massachusetts.

Ever since the landing of the Pilgrims, the alewife fishery has been closely related to the progress or poverty of the shore towns. The fishery not only supplied food and fertilizer for the early inhabitants, but proved of great value (though that fact is even yet unappreciated) in attracting the large schools of fish such as pollock, blue fish, striped bass, squeteague, mackerel and other food fish, to our shores. With the decline of the alewife fisheries, due to various causes, notably unwise legislation leading to excessive fishing and the inroads of "civilization," there has been a corresponding decrease in the entire shore fisheries which demonstrates that the success of the fishing towns of our coast is dependent in considerable measure upon the condition of the alewife fishery. Conditions at the present time warrant the statement that by proper handling and restriction the fisheries of many streams can be brought back to their state of former abundance.

Natural History of the Alewife.—The alewife or branch herring is a member of the great herring family or *Clupeidae* and belongs to that class which ascends the tidal rivers for the purpose of spawning. It has even become landlocked in the lakes of New York, although essentially a salt water species. The common names of this species are Branch Herring, Spring Herring, Alewife in New England with the modification of Ellwife or Ellwhop in the Connecticut River, Big-eyed or Wall-eyed Herring in the Albemarle River, Grayback (to distinguish it from the Blueback or Glut Herring (*P. aestivolis*) which arrives after the alewife), and Gaspereau in Canada.

The alewife is found along the Atlantic coast of the United states from Nova Scotia to Virginia, the range being from the Gulf of St. Lawrence to Cape May. In former days practically all the Massachusetts tidal rivers and streams were populated with this species of fish; but owing to the intervention of man the alewife has been extirpated in many localities and enormously diminished in all.

The spawning season in Massachusetts varies from year to year, but may begin as early as March and extend even until early June, during which period the alewife ascends the fresh water streams to the ponds at the head of the stream to spawn, and returns during May and June to the ocean. The eggs, measuring one-twentieth of an inch in diameter, adhere to each other and to various objects in the water. They are fairly hardy and survive conditions that would be fatal to the eggs of more susceptible fish. It is reported that falls and dams exceeding 2½ feet high prevent the passage of these fish to the spawning ground. On the other hand they readily mount fish ways of various types, selecting the greater current. In Massachusetts two classes of spawning grounds are found: (1) the ordinary brook or river with a tidal estuary into which empties fresh water, which rises in springs, ponds or lakes in many instances several miles from the ocean; and (2) the typical fresh water shore pond, lying close to the salt water, separated only by a narrow sand beach with a natural, shifting or artificial opening. The alewife fisheries on Martha's Vineyard are in ponds of this type.

Through artificial openings the alewives enter, during the spawning seasons, directly into the ponds from the salt water.

The alewife increases rapidly in size in the fresh water ponds, and by late summer obtains an approximate length of from two to four inches, when it descends from the breeding ground to the ocean, unless prevented by artificial structures such as cranberry bogs, dams, etc.

Little is known of the subsequent life of the alewife. It is commonly supposed that the same alewife will return three or four years later as a full grown fish to the same stream for the purpose of spawning. This is what is known as "the parent stream theory," and is in all probability, correct, although positive proof is difficult to obtain. Upon this assumption is based the plans for the future re-establishment of the alewife fishery, since by placing the spawning adult in the headwaters of the depleted alewife streams the fishery can once more be re-established. Where the alewife passes the period of its growth has not been definitely ascertained. It is probable that it remains in the deeper ocean water, but not far from the mouth of the stream whence it descended.

History of the Fishery.—In the early colonial records mention is made of the alewife as providing food for the first inhabitants of New England. At this time the fisheries were free and the supply greatly in excess of the needs of the population. Every inhabitant who was "a householder had the right of free fishing and fowling in any of the great ponds, bays, coves, and rivers so far as the sea ebbs and flows within the precincts of the town where he lived unless the freemen of the same town or the general court had otherwise appropriated it." Captain John Smith in his description of New England as relating to the fisheries, particularly the alewife and the cod, said, "If a man worked three days in a season, he would get more than he could spend in the entire year if his expenditures were not excessive." Cod were then worth ten shillings a hundred and the poor fisherman could take from one hundred to three hundred a day.

The alewife fishery in each town was early made a public town asset, and held for the inhabitants of that town. The fishery was either regulated by the selectmen and the "herring committee," or else was sold at auction or private sale to certain individuals for a stated sum with a proviso, e. g. that each inhabitant who so desired should be entitled to purchase one hundred fish at the price of one-half a cent apiece.

As long as the fish were abundant and the population small, there was no decline in the fishery, but with the increase in population and the encroachments of civilization the alewife fishery began slowly but steadily to decline until at the present time only a remnant of the former abundance remains. It is safe to say that, taken as a whole, the alewife fishery has deteriorated approximately 75% from the original condition, and that there are only a few streams in Massachusetts which produce anywhere near their normal yield.

The causes of the decline are as follows:

(1) *Over-fishing.*—In spite of the laws restricting the time of taking the fish to certain days, little judgment was used by the men in charge of the fisheries, as too many alewives were taken and too few allowed to pass the spawning grounds. An instance of this short-sightedness is shown by the following case where on one stream which passed through three towns the time of fishing was regulated to three days a week, but it was so arranged that the fish were taken at places and times in the week covering every day for the reason that each town had three different days for catching the fish. Any fish that succeeded in getting by the first town would likely be taken in their passage through the second town, and if not taken there the escaping survivors almost certainly met their fate in the third town.

(2) *Dams.*—Obstructions to the streams by dams prevented the passage of fish to the spawning grounds. In all cases the laws explicitly stated that satisfactory pas-

sageways for the fish should be made over all dams, but in spite of the enactment and intent of these good laws, they were either evaded or defied by the mill owners with the result that in three-fourths of the alewife streams there are, at the present time, from one to three dams without suitably equipped fishways for the passage of the alewives.

(3) *Cranberry Bogs.*—In southern Massachusetts the development of cranberry bogs along the alewife streams with the frequent dams and obstructions have proved a serious drawback to the success of the alewife fishery, as the cranberry industry has been considered of more value than the fishery, and the owners have not been required to provide suitable passageways for the fish. The profits of the cranberry bogs are usually sufficient to warrant a reasonable outlay in maintaining the rights of the fisheries.

(4) *Other Obstructions.*—In spite of laws, private persons have placed various obstructions in the different streams which have prohibited the passage of the alewives to their spawning grounds.

(5) *Deforestation and Pollution.*—The pollution of the streams from manufacturing sources has likewise proved detrimental to the life and passage of the fish, and many streams already reduced in volume as a result of deforestation are temporarily ruined for the shad and alewife fisheries by the quantities of chemicals and other poisonous substances which have been turned into the water.

(6) *Laws.*—Legislative remedies, first applied in 1741, have been cumulatively restrictive and unsystematic rather than constructive, and few attempts have been made to restock or replenish the supply of fish at the spawning grounds. The aim of past legislation has been rather to restrict the catch than to increase the production,—a fundamentally wrong economic principle. Future legislation should be on both types, constructive as affects replenishment of the various streams, and restrictive only in such measure as to ensure the best results from the restocking. On the whole, the legis-

lation relative to the alewife streams when not, as often, confusing and conflicting, has been good, and if the provisions of the laws could have been adequately enforced by the towns assuming such responsibilities, there would probably have been little or no decline in the fishery. Unfortunately, the provisions of many excellent laws were not enforced and the result was the same as if no laws were upon the statute books.

Results of Annual Sales.—Very early the plan of leasing the fisheries to the highest bidders was instituted. This scheme has proved one of the most serious causes of the decline of the fishery. The leases were given for short intervals, frequently for one year, and the lessee endeavored to get all he could out of the fishery for the year without considering the future welfare of the fishery. Thus, for instance, streams where originally the alewife fishery was sold for as high as three thousand dollars are sold today for a mere pittance of five dollars or are not worth selling at all.

Present Conditions.—During the past two years the condition of the alewife fishery in every coastal stream of the Commonwealth has been thoroughly investigated by the Massachusetts Commission on Fisheries and Game, and the streams which are worth reclaiming have been noted. The conditions at the present time are deplorable. In most instances the towns take little or no interest in the fishery, and are perfectly willing to let the industry pass away. In other cases, the towns jealously guard their rights over the alewife streams, but in most cases do not show any desire or aptitude to improve the conditions, but strenuously object to outside interference, especially on the part of the State. It can fairly be said that the alewife fishery at the present time is in a deplorable condition, and if this State asset is to be saved, radical and immediate action on the part of centralized State control is essential.

Value of the Fishery.—The special value of the alewife arises from the fact that it is one of the few fish that "furnishes its own transportation"; coming in the early spring to the very doors of the poor people. In the small streams, it is easily caught without expense, and has been used in the past not only for food but for fertilizer and has well paid. Within my recollection, in the Merrimac River, shad and alewives were used as fertilizer by the farmers in the immediate neighborhood. Today rarely does a single shad enter the river and the alewives are very few. This has been brought about by pollution in the manufacturing sections and by the large dams upon the river.

Alewives are still used considerably for bait and are a valuable asset. Twenty or thirty vessels come annually to Edgartown, each taking forty thousand alewives for bait. The value of the fishery to a town may in favorable seasons run as high as four or five thousand dollars. The organized companies average about 15% profit on the capital invested in addition to the fact that they distribute a considerable amount of money in wages among worthy people.

The situation is made the more imperative for the reason that the shad, which formerly came with the alewife to these same streams, and which by identical methods, conditions and causes have been practically exterminated, by the wise, patient and effective methods of the U. S. Bureau of Fisheries have been re-established in many streams, to the great economic advantage of the nation. Common sense methods applied to the alewife fishery will assist greatly in making possible again an annual catch of shad in Massachusetts waters. But after all, the greatest value of the alewife fishery is one that is little considered by the average person, viz., the value of the alewife as a food for the larger fish which frequent the Massachusetts waters. The small alewife in the fresh water ponds not only furnishes a source of food to the bass, pickerel, and other fresh water fish, but when it descends to the ocean it attracts to the vicinity of the streams large quantities of bluefish, squeteague, pollock, and other fish which prey upon both the small alewife and the adult. We have lost sight of the fact that these alewives are an important fish as a means of attracting the other marketable fish to the whole Atlantic shores, and one cause of the decline in the shore fisheries can be attributed to the destruction of the alewife fisheries in the coastal streams. Therefore, there is firm ground for the opinion that the alewife fisheries, far from being solely a town asset, or even of concern to this State alone, are in fact an important national asset, and as such should be subject to Federal regulation for the benefit of all the fish consumers of every State in the Union whither fresh or prepared sea fish are shipped from the coastal States.

The Remedy.—The solution of this problem lies entirely, in my opinion, in Federal or at least in State control as distinct from town control. Restrictive legislation is not a rapid and economical method for increasing the quantity of fish, but almost invariably, in my experience, restricts the demand without increasing the supply. Two things are absolutely essential for the development of the alewife fishery. The first is that a sufficient quantity of alewives get to the spawning ground at the head waters of the stream by removing all obstructions to or by providing suitable devices for the passage; secondly, placing spawning alewives or eyed eggs in ponds at the head waters of the streams to re-establish fisheries which have become extinct. The regulation of the fisheries must be conducted in such a manner that the right proportion of the fish be allowed to pass up the stream to the spawning ground. This can only be done by people who are interested in the welfare of the fishery, rather than in getting all the money they can from the fishery. The fishery should be taken from the hands of the selectmen who have proved incompetent or too busy to handle the problem, and placed in the hands of a competent State board which could regulate the fishery by a scientific and uniform system both as regards stocking and removing of obstructions, and the correct regulations for the future development of the fishery. If the fishery is to be sold to the highest bidder, the term of years should be extended to at least ten in order that the purchaser should develop the fishery and not work it for all that is in it.

Not only people in the shore towns but all the fishermen along the coast and the entire body of consumers are interested in the alewife fishery and in the consideration of a question which is not merely confined to the coastal streams and the shore towns, but extends to the entire fisheries of the State and even far beyond to the interests of the fisheries of the nation.

NOTES ON THE MONTANA GRAYLING

By W. M. Bickford,
Montana State Fish Commission, Missoula, Mont.

It is possible that a word concerning the Montana Grayling may be of interest, especially when considered in connection with its introduction by artificial propagation into waters tributary to the Pacific Ocean. The Grayling which for gameness is not surpassed by the trout, and so far as flavor on the table or beauty in the stream is concerned, is hardly equalled by any fresh water fish, is native to the waters of northern Michigan, Montana (in the upper branches of the Missouri river) and Alaska in the streams tributary to the Yukon.

There is such a close resemblance between the species found in Michigan, Alaska and Montana, that it is hardly necessary to enter upon a discussion of the slight differences in structure, although they are recognizable, and the Montana Grayling is given a rank of its own. The fish was first noticed in Montana and described by Lewis and Clark in the report of their trip of exploration to the Pacific in 1803, and later was classified by James W. Millner of the United Fish Commission.

Until Dr. James A. Henshall, at that time Superintendent of the United States Fisheries Station at Bozeman, Montana, undertook to raise the grayling, no effort had been made to stock streams with this very desirable game fish.*

The efforts toward artificial propagation were not at first successful, but with the patience and skill of a vetern, Dr. Henshall, after two or three efforts, succeeded, and between the years 1898 and 1907, distributed 17,343,026 fry and fingerlings from the Bozeman station.

So far as is known none of these fish were planted in streams flowing into the Pacific. It was not until the State of Montana established its hatchery at Anaconda,

*Seth Green hatched and reared Michigan Grayling at Caledonia, N. Y., in 1874.

that any effort was made to stock streams other than those in which the grayling was native.

In 1909 the State Fish Commission of Montana obtained a quantity of grayling eggs and planted over one million fry in Georgetown Lake, which is located on the headwaters of Flint Creek, which flows toward the Pacific.

For two years, nothing was known as to the result of the planting, but at the end of this time fishermen reported catching grayling in Georgetown Lake, but only in small numbers. The third year many were caught, some of them weighing two pounds and over, and at the end of two years and a half reports were received that grayling weighing in the neighborhood of five pounds had been caught in this lake. As the fish rarely reaches a weight of two pounds in its native habitat the large size of those caught can only be accounted for on the theory that the water temperature and food supply in Georgetown Lake are both favorable to large growth. The State Fish Commission has thus succeeded in planting the grayling in at least one stream which flows westward to the Pacific and the success attained encourages further efforts in this direction.

That the fish have taken kindly to their new home is shown by the fact that during the spawning season of 1913, they entered the two inlets to this lake in great numbers to spawn. At one time there were held in the traps set for catching them, over eleven thousand of spawning age, from which were taken about fifteen million eggs which were handled in the hatchery at Anaconda, but with only partial success. The fry, which resulted from the eggs taken, were many of them planted in other streams on the west side of the Rocky Mountains and favorable results are hoped for.

In 1910 there were planted in the Bitter Root River, about fifty thousand grayling fry, and in 1911 and 1912 other plantings were made, but so far no results have been noticed. While reports are at times received that grayling have been caught, no specimens have been submitted for examination.

The Bitter Root River is a large fine trout stream and seems an ideal home for the grayling, and much interest is manifested in the result of the planting. Nothing could be more successful than the stocking of Georgetown Lake, hence the hope for similar results elsewhere.

To those who know and have fished for the grayling, or who have tasted its delicious flesh the stocking of suitable streams with this fish is a matter of much interest. The Montana waters which are profusely supplied with this fish are the Madison, Jefferson, Gallatin, Red Rock and Bighole Rivers, and many of the lakes found at the heads of these streams are also well supplied.

Should the details with reference to the propagation of the grayling be desired, attention is called to Bureau of Fisheries Document No. 628, where full information is given. It is the belief of the writer that an effort should be made to stock streams along the Atlantic seaboard with this fish.* They multiply rapidly, have all the game qualities of the trout, are unexcelled as a food fish and to the sportsman are a source of great pleasure, because they take the fly readily and make a game fight.

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*The experiment was made long ago in New York and abandoned. Montana Grayling were planted in Sunapee Lake, N. H., in 1904, 1906 and 1907, but Mr. W. C. Kendall (Bureau of Fisheries Document 783, 1913) states that there is no evidence of any success. Conditions appear to be unfavorable in our waters.—*Editor.*

THE FISH TRADE ORGANIZATIONS

By Frederick F. Dimick,
Secretary, Boston Fish Bureau, Boston, Mass.

The purpose of this paper is to present to the visiting members a brief outline of the work that is being done by the principal trade organizations of this city.

The Boston Fish Bureau was organized in June, 1875, in order to collect information relating to the fishing industry, to preserve statistics for reference, to discuss in a friendly manner and to act jointly on all matters pertaining to the fish trade.

It aims to secure reliable news in regard to the arrival, sale, catch and shipment of fish. This information is published in bulletins, from three to six daily, that are delivered to resident members by messengers, and to non-resident members by mail. In these days when reliable facts and figures enter largely into the successful prosecution of any business, the value of the Bureau is obvious.

Interest in the Bureau has grown steadily until its membership comprises the larger part of the salt fish, fresh fish, canned goods and lobster trades of our city and with them the leading merchants in Gloucester, New York, Philadelphia, Providence, Albany, St. Louis and Halifax.

The rooms of the Bureau are commodious and centrally located. Here are kept on file the weekly and yearly reports, the reports of the United States Bureau of Fisheries, the Department of Fisheries of Canada, of Newfoundland and other governments, which have proved interesting and valuable to any and all seeking information.

The members of the press recognize the value of our reports and are frequent visitors to our rooms, and the principal material for their daily and weekly reports are furnished by the Bureau.

Its correspondents constitute the best recognized authorities in every city and town the entire length of the American and Nova Scotia coasts, where fish are landed and prepared for market. Recognizing the necessity of reliable information at the earliest moment, the Bureau has, in all eastern cities, correspondents who telegraph the moment a cargo is loaded, stating the nature and quantity. This enables the trade to know, twenty-four hours previous to the arrival of the goods, what may be expected, all of which has proved of great value.

The fishermen find the reports of the Bureau are an aid to them in locating schools of fish. It also informs them of places along the coast where they can obtain bait.

The New England Fish Exchange was organized in the year 1905 and has large and commodious quarters at the end of T Wharf, convenient for the dealers and fishermen. The purpose of the Exchange is to maintain a room for the purchase and sale of fish. The sales which were formerly made on the wharf are now all made in the room of the Exchange. It guarantees the consummation of all sales and purchases registered on the exchange, and is a sort of clearing house for the fresh fish trade.

The Exchange has improved the condition of the fresh fish industry, and a better feeling exists between the captains and the dealers. It aims to improve the sanitary conditions of the fresh fish trade of Boston. A credit association maintained by the Exchange has proven a valuable adjunct to the trade.

The Exchange has recently published a book entitled, "Recipes for Sea Food," which contains valuable information on how to preserve, prepare and serve fish; extracts from the fish and game laws, and other valuable information. The distribution of this book in the homes of the people and in the libraries ought to be a great benefit to the fishing industry.

The Boston Fish Market Corporation is a business organization that has charge of the leasing of wharf property occupied by the fresh fish trade. They are lessees of the new Commonwealth dock in South Boston, which is made entirely of cement, brick and glazed tile, thoroughly hygienic and fireproof. It provides dock berths for forty vessels. The property contains an Administration building, cold storage and power plants, and two long buildings containing forty-four fish stores. The entire property comprises 537,100 square feet. Spur tracks on the property will make railroad facilities ample to all parts of the country. It is the best appointed and second largest fish market in the world.

The Boston Lobster Dealers' Association was organized last winter and has headquarters on Long Wharf. Here the lobster dealers have regular meetings during the lobster season and have made progress in bettering the conditions of the lobster trade. The special attention of this association is directed to the handling of the large quantities of lobsters which are received in this city from Nova Scotia.

The Fishing Masters' Association, as the name implies, is composed of the captains of the fishing fleet. They hold special meetings and take action on questions concerning their own welfare. A feature of this association is the publication annually of a book entitled "Fishermen of the Atlantic," which contains a list of the fishing vessels, and much other valuable information relating to the fishing industry.

A considerable number of those engaged in the fish trade are members of the Boston Chamber of Commerce, which has a membership of 4,000 and is a great factor in the civic and industrial progress of Boston and New England.

EXPERIMENTS IN FISH CULTURE

By Philip G. Zalsman.

Trout culture has been so much discussed that very little that is new remains to be said. I wish, however, to give the results of some experiments in crossing Brook, German Brown, Silver or Lake Tahoe, Rainbow and Lake Trout.* It is commonly supposed to be quite difficult to cross some species of trout, especially the rainbow and brook, but with the latter cross my experiments have been successful.

I have crossed brown trout eggs with brook trout milt and *vice versa.* These eggs did very well and some of them hatched out nicely, but I doubt if either cross will produce eggs or milt. Silver trout eggs were also crossed with brook trout milt, the resulting females producing eggs. In this cross the back of the fish resembles the brook trout, but the lower part of the body is similar to the silver trout.

Crossing rainbow trout eggs with brook trout milt also gave successful results, though I am not aware that this has been done before. In correspondence with the Commissioner of Fisheries I was informed that in their attempts to produce this cross at various stations "the results have been of a negative character." I also crossed the brook trout eggs with rainbow trout milt, but was not so successful, though I did raise some to the feeding stage. I was obliged to take the eggs in February from some stragglers, which of course were not so good as those taken in the earlier part of the season.

The following table gives some results of experiments in fertilizing brook trout eggs under various conditions:

Experiment 1:	Condition of eggs.	Condition of milt.	Resulting hatch.
	Fresh.	Fresh.	Good.
	After 15 min.	After 15 min.	15%
	After 1 hr.	After 1 hr.	0

*These experiments were carried on while in the employ of the Michigan and Wisconsin State Fish Commissions.

	Condition of eggs.	Condition of milt.	Resulting hatch.
Experiment 2:	After 5 min.	After 5 min.	25%
	After 1 hr.	Fresh.	10%
	Fresh.	After 1 hr.	0
Experiment 3:	After 1 min.	Fresh.	90%
	After 2 min.	Fresh.	80%
	After 3 min.	Fresh.	70%
	After 5 min.	Fresh.	40%
	After 10 min.	Fresh.	20%

These experiments show that unfertilized eggs live longer than milt at the same temperature, and that the sooner the milt is placed with the eggs the better.

If the temperature is too low the trout spermatozoa seem unable to enter the eggs for impregnation. If a little warm water is used when the air is cold at spawning time the eggs are fertilized more successfully, and this is especially true for the rainbow trout. The cross between the rainbow and brook trouts cannot be made successfully in cold water.

Eggs were taken from a ripe brook after it had been dead for an hour and a half, and fresh milt was added. About 5 per cent. of the eggs were impregnated.

A female and three male brook trout were taken in the spawning season and put in a tank by themselves. On November 2nd I took part of the eggs, again on the 5th and the balance on the 9th, using the three males every time. I could not see any difference in the impregnation of these eggs.

Some years ago, lake and brook trout were crossed by Mr. Marks, of Michigan. These females produced eggs and were again crossed with brook trout, making hybrids three-fourths brook trout.

Yearling brook trout, reared in a clay bottom pond covered with shades, were transferred to another station where they had sandy bottom and no shades. The bright sun shining on the sand caused the death of nearly all of them. The fish were curved up like a new moon or quarter-round. Shades should be provided for ponds with sandy bottom. I have known the sun to kill nearly all the fry in a box tank, when the cover was lifted on a bright day.

Fry hatched prematurely are not good. Care should be taken in transferring eyed eggs that the temperature does not get any warmer than the water from which the eggs were taken. Also the water feeding a hatchery should be kept at as constant a temperature as possible. A sudden rise or fall at hatching time will cause a premature hatch. These fry will live until they have outgrown their yolk sac and sometimes a week or two longer, but they do not seem to be able to feed and finally die.

(Many similar experiments in hybridization were made at Caledonia, N. Y., by Seth Green forty years ago. Hybrids between a large-scaled species, such as the rainbow and brook trout or other small-scaled species are sterile. T. H. Bean.)

SMALL-MOUTH BLACK BASS

By Charles H. Nesley, *Copake, N. Y.*

From the first day when I turned my attention to the culture of the small-mouth black-bass, I felt convinced that there was something radically wrong in the system used by most of the bass culturists in Pennsylvania and other states.

The matter I am now bringing before you is not the result of a sudden invention, but rather the work of devotion to the perfection of the culture of the small-mouth black bass.

In 1905, 1906 and 1907, I noted that the cribbing of bass was a waste of time, and in 1908 it was abandoned by the Department of Fisheries of Pennsylvania, then under the direction of the Hon. W. E. Meehan.

Under order of Mr. Meehan field work on black bass was started in Pennsylvania as early as 1906, in Wayne and Lackawanna Counties, with great success. It was there that I first found that larger bodies of water are not subject to the sudden changes of temperature which I have since found the worst thing to contend with in the artificial pond culture of black bass.

At the Torresdale, Conneaut Lake, Willow Brook and Hiram Peoples' hatcheries in Pennsylvania, black bass were being reared every year, but what did they cost? This is the point I am bringing before you for your consideration. Artificial pond culture of bass for breeding is not a success, nor has it ever been. All have some degree of success, but none can compete with the man who gets his bass in the larger lakes. I find that Pennsylvania has almost entirely abandoned the system of artificial pond culture. Some of the private hatcheries are still hanging on, but what Pennsylvania has done, I believe, is very practical. It gets its bass in the large lakes with less than one-tenth the cost. There are, of course, private hatcheries having no access to the natural lakes of Pennsylvania, but still there are many lakes owned by private parties in Pennsylvania and other states that are just the right places to raise bass as a commercial enterprise.

For illustration, take Robinson Lake, owned by Mr. Ernest C. Brown, in Columbia County, New York. It is thirty feet deep and well stocked with bass. I personally counted over five hundred nests of the small-mouth bass. This year they started to spawn on April 22, and continued until the 18th of May, the temperature at this time being 56 degrees Fahr.

During a spell of six or eight cold nights, the temperature fell only three degrees. I went to Snider's Pond about a mile away, and there found that the temperature had dropped to 42. Here the eggs on most of the bass nests were dead and had been deserted, making them a total loss. Snider's Pond is shallow and subject to sudden changes in temperature while deeper lakes are not. I am sure that between 250,000 and 300,000 young bass could have been gathered in the first-named body of water. At this time the hatchery at Lake Waramaug was unable to fill the orders and the same condition was true at Hiram People's.

As Robinson's Lake is fairly well stocked with the Daphniae or "mijinko,"* the shipping of bass, as advanced fry, could be done directly from the lake with practically no expense. There is no hatchery account to be kept up, no mature bass to feed, therefore practically no outlay, nothing but gain. Field work may also be done in the same body of water for Yellow Perch, Rock Bass and Sunfish. All there is to it is the gathering of a reasonably sure crop every year, and no time is wasted in catching minnows to feed the larger bass.

In some of the states, New York for instance, the bass are not fed, but are taken in the spring shortly before spawning commences, which, for the sake of economy, I find practical. But the culture must be carried on in artificial ponds and hence is subject to any sudden change

*This is a Japanese term to include the minute crustacea such as *Daphnia, Cyclops,* etc., which form the natural food of many young fishes.—*Editor.*

in temperature. It is more practical, however, than the keeping and feeding of bass all the year round. I am satisfied from very close observation that when the bass are obtained by field work, the greatest part of the expense is saved, and that bass can be shipped and distributed from such sources at less than one-tenth the cost of artificial pond culture.

CONCERNING YOUNG BLUEFISH

By J. T. Nichols,
American Museum of Natural History, New York City.

It is my purpose to call attention to the value of having in museums extensive collections of the young of different fishes, and to the fact that such collections of young fishes are of prime importance in studying the habits of the species.

Unfortunately the American Museum of Natural History in New York has meager collections of such material, yet they will illustrate my meaning.

Young Bluefish, known as Snappers, abound in the inshore waters about New York in summer. They are extensively fished for with light rods for sport and food, and they are a most excellent panfish, tasting like the adult Bluefish, but sweeter and more delicate. To catch them, a light rod is used; the hook is kept usually two or three feet below the surface, baited with smaller fish alive or dead, *Fundulus* or *Menidia* generally preferred; but at times they bite voraciously on clam or worm bait.

Fishing commences in August, when the Snappers are about 4½ inches long (without tail fin). The Museum has specimens 4½ inches, Cold Spring Harbor, Long Island, August 12th; and 4¾ from the same locality in August. They grow rapidly and in September reach a length of 7 inches, with a weight of say 3 ounces. Specimens from Sandy Hook, October 8, 1897, are 6¼ and 7¼ inches long; one from the Hudson River, September 24, 1881, 7½ inches long.

On August 22, 1913, Dr. William H. Wiegmann of New York, found young Snappers being caught abundantly at Sheepshead Bay, and at the writer's request made measurements of 49 individuals. Five were 13 to 13.5 cm. (5¼ in.), six 16.5 cm. (6½ in.), eight 17 cm. (6¾ in.), thirty 17.5 to 18 cm. (7 in.) long.

The gap in sizes between the five smallest and the others is noticeable. In this connection we may note a similar gap in fish at Lloyd's Point, on July 30.

On August 18 to 20, at Prince's Bay, Staten Island, seven fish 4½ to 5 inches long were obtained by the writer, and others of about the same size observed. It will be noticed that these agree very well in size with the smaller ones at Sheepshead Bay of a corresponding date.

It is reported that on September 7 many Snappers were taken at Prince's Bay about 6 inches in length, but the Sheepshead Bay fish were mostly larger, for Dr. Wiegmann measured about 100 there on August 30 with average size 18 cm. (7 in.).

On July 30, 1913, the writer found small Snappers 1⅝ to 2 inches long, swimming in close-ranked schools like mullet or herrings, at Lloyd's Point, Long Island. In the water they looked distinctly silvery and deep, with dark ends to their tails. A small detachment rather close in to the gravelly shore was rounded up with a minnow seine, and about forty little fish all about of a size captured, verifying the identification of the others that had been seen. At this date there were also a few larger fish, perhaps 3½ inches long, in smaller companies much swifter and wider ranging, already beginning to strike at the regulation bait. Probably there is a marked change in habit at about this age. Well-preserved material which would admit of critical stomach examination would make this easy to determine, but unfortunately our Museum does not possess such material at present.

In past years the writer has seen a few much smaller fish, probably less than an inch in length, occurring singly in sheltered waters on the ocean side of Long Island, near New York. These were weak-swimming, and easy to capture, like baby trout or salmon in the shallows at the edges of the streams where they breed,—fishes which a little later are leading a more active and predaceous life in the channels of the same streams. Unfortunately he has now no specimens of these smallest Bluefish preserved from which accurate dates and measurements could be obtained.

The evidence, however, is clear that the Bluefish spawns off our shores in early summer, and there is material to show the growth of the young while with us.

According to Dr. G. Brown Goode, "American Fishes," 1888: "The Hon. Robert B. Roosevelt records that he observed the Bluefish fry less than an inch in length in the inlet of Far Rockaway, N. Y., on the 10th of July . . . . Dr. Yarrow does not give any facts in regard to this subject, at Fort Macon, except that spawn was seen to run out of a small female caught July 14th . . . . The only positive evidence . . . . is that of Capt. Pease, who states it as the general impression about Edgartown that they spawn about the last of July or the first of August. He has seen them when he thought they were spawning on the sand, having caught them a short time before, full of spawn, and finding them afterward for a time thin and weak. He thinks their spawning ground is on the white sandy bottom to the eastward of Martha's Vineyard, toward Muskeeget."

Dr. Tarleton H. Bean, writing in the report of the New York Forest, Fish and Game Commission for 1900, gives a detailed statement of the sizes of young Bluefish in Great South Bay in the summer of 1901. He says, "The smallest individual taken in July measured 3⅛ inches. In the first half of September the lengths varied from 3⅝ to 7¼ inches. Young Bluefish 7¼ inches long were caught in August . . . . a single young bluefish 7½ inches long was seined in the foot portion of Swan River, September 9."

It will be seen that these sizes agree very well with those given above, but show a wider variation. Probably the former give a fair idea of the average of the schools.

There is also material to show that the season is earlier further south. In the Museum collections a single specimen 4½ inches long, from Cape Sable, Florida, February 9, 1910, and five 3 to 3½ inches long, from Marco Pass, Florida, February 15, 1910, indicate that it is five months earlier in Florida.

In conclusion we may deduce the following generalizations, subject to much indefiniteness and some uncertainty, from our scanty evidence:

In the latitude of New York, the Bluefish spawns in early summer. The young are less than an inch long in early July, two inches long by the first of August, five to seven inches (with say 3 ounces weight) by September; and the season is earlier further south.*

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*Young Bluefish, taken abundantly in the traps off Sea Bright, N. J., Sept. 20, 1913, ranged from 6¾ to 10 inches in length.

THE ATLANTIC SALMON

By Chas. G. Atkins,
U. S. Bureau of Fisheries, East Orland, Me.

The Atlantic Salmon (*Salmo salar*) occupies a very prominent place in the ranks of the species that have been the subjects of artificial propagation. Inhabiting naturally nearly or quite every river tributary to the Atlantic, north of the 43d degree of latitude on the European side and of the 40th degree on the American side, it has attracted attention of fish culturists in those countries where modern fish culture had its birth and has been most earnestly pursued. Its culture has been pursued in all the countries of northern and western Europe as far south as France and on the western side in Canada and the United States.

The life history of the Atlantic salmon has been much studied, and the following may be considered as well established: Passing the winter and early spring within the egg in a fresh water stream and very slowly developing, it bursts the shell in the spring, early or late, according to location, and then passes a year or two in its native river, attaining at the end of two years, a length of about 8 inches. It then goes down to the sea, where it stays several years, returning to its native river when full grown, weighing 8 lbs. or more, to deposit its eggs. In the rivers of Canada, as in those of the British Islands, great numbers of the salmon come in when they weigh only from 2 to 6 lbs., at which stage they are termed "grilse," but they rarely enter the rivers of Maine at this stage of growth.

The "run" of salmon in the Penobscot river begins in April and continues through May and June, and a few come in in July, or even later. If able to pass the obstructions in this river they ascend to various distances, many of them more than a hundred miles from tide water, and lie there until late in October, when they begin to spawn, the female digging holes in the gravelly bottom of the rapids and covering the eggs with gravel. A male at-tends each female, fertilizing the eggs after they are laid and meanwhile chasing away all intruding fishes. The embryos begin their development at once and continue all winter, hatching for the most part in April.

The first spawning of a Penobscot salmon is apparently at the age of four years and a half. She then returns leisurely to the sea, generally reaching it the next spring or early summer, in a very emaciated condition, in consequence of total abstinence from food during the whole period of her stay in fresh water. She now resumes feeding and rapidly recovers condition, and, after a full year in the sea, is ready to ascend the river again to spawn a second time. In a few cases it doubtless happens that the fish makes a third visit to the river, thus laying three lots of eggs during her life. The facts pertaining to the return of the salmon for a second spawning were ascertained by experiments at Bucksport and Orland between 1872 and 1880, when a total of over 1,200 salmon of both sexes were marked on their release after spawning. The mark was in the form of a small aluminum tag attached by a fine platinum wire to the rear margin of the main dorsal fin, each tag stamped with a number which referred to a record showing the date of marking, the sex of the fish, its length and weight, and, if a female, the quantity of eggs yielded. The fishes bearing these tags were released in November in tide-water and doubtless in nearly all cases soon went out to sea. A year from the next spring and summer a few of them were recovered through the salmon fishermen of the Penobscot, with the tags still in place, when in every instance, it was found that the fish had fully recovered from the emaciated condition in which it had been dismissed, and had made an increase in weight and length over the condition when first handled. Out of the 1,200 marked, nearly 40 were recovered. This is a small percentage and it is entirely probable that far more than that number survived and returned without the tags, and possibly in some cases the tags escaped notice by the fishermen. Indeed, it may be regarded as remarkable that, with the fish almost constantly in motion for so many months, and the tag swinging back and forth, the fine wires did not cut their way out from the margin of the fin in all cases.

The culture of this species of salmon now conducted at the Craig Brook station has for its prime object the maintenance of the species in the Penobscot river, which alone furnishes the material on which the work is based. The first step is the collection of breeding adults, which has thus far been done on their first appearance in the river when bound for their spawning grounds. In the lower part of the river and about its mouth a large number of weirs are each year built of stakes, brush and netting for the capture of salmon and alewives. Arrangements are made with a large number of weir fishermen to save their salmon alive, for which purpose they are supplied with soft nets, boxes and cars. For cars, common fishing dories are used; openings in their sides permitting the free ingress and egress of water when they are in motion, gratings at the openings and a cover of netting preventing the escape of the fish. Once a day near low water a motor boat traverses the fishing district and tows all the cars containing salmon up Orland river to a point in a fresh water tributary, Dead Brook, where there is constructed an enclosure occupying the entire stream for about a third of a mile in length, the width averaging about two rods and the depth ranging from four to twelve feet. Here the salmon are placed with free range through the enclosure. The collection is begun about May 20 and generally closed some time in June, several hundred salmon—sometimes more than a thousand—being collected. No food is offered them, and it is not believed that they would accept any if offered. There seems no doubt that it is their habit to abstain from food wholly during their stay in fresh water. Early in the history of this work more than a hundred stomachs taken at random from those cut up in the Bucksport markets, were saved and submitted to examination by experts in Washington, who could find nothing in any of them that appeared to be food or the remnants of food.

It therefore seems that the salmon cease to eat before they enter the river.

In the Dead Brook enclosure the salmon seem to find an ideal abode, and the deaths among them during the season appear to be caused by serious wounds received in capture, or, as sometimes happens, by excessively high temperature of water in July or August. Meanwhile their reproductive organs undergo a normal development and about the 20th or 22d of October the most forward of them are ready to lay their eggs. When they reach this condition they try to find swift water and, working up the stream, are entrapped at the head of their enclosure, dipped out and manipulated. When the salmon are collected, no attempt is made to distinguish between the sexes, but it has always turned out at the spawning season that the females are more numerous than the males. A rough shed shelters the workmen and here the eggs are taken and fecundated and packed on trays in which they are carefully conveyed to the Craig Brook hatchery, some two miles distant. Here the incubation is carried to the shipping point, and most of the eggs are then transferred for hatching to an auxiliary station at Little Spring Brook, a tributary of the East Branch of the Penobscot, situated about 120 miles above the mouth of the river. The fry hatched here are all liberated in the Penobscot river within a few miles of the hatchery, on the very grounds where they would have hatched naturally had their mothers been allowed to follow their natural instincts. A few of the eggs have sometimes been hatched at the Craig Brook Station and the resulting fry placed in the Penobscot or tributaries nearer the sea.

During the past ten years the number of young salmon artificially hatched and thus liberated in the Penobscot has been as follows:

Year	Planted in upper Penobscot, E. Branch	Planted in other Parts of Penobscot	Total
1905	727,462	289,102	1,016,564
1906	1,897,607	79,217	1,976,824
1907	2,156,852	39,830	2,196,682
1908	2,059,514	50,003	2,559,514
1909	647,790	24,430	672,220

Year	Planted in upper Penobscot, E. Branch	Planted in other Parts of Penobscot	Total
1910	1,299,779	155,609	1,455,388
1911	2,854,084	19,000	2,873,084
1912	1,841,221	22,711	1,863,932
1913	3,482,464	4,304	3,486,768

The adult salmon in store at Dead Brook are sufficient to justify a result for 1914 fully equal to that of 1913.

The effect of this work on the product of the salmon fisheries of the Penobscot is shown by the statistics of the catch in the counties of Hancock, Penobscot, Waldo and Knox, collected by the Maine Commissioner of Sea and Shore Fisheries. The total catch in these counties for several years was as follows:

Year	Catch of Salmon in lbs.
1905	52,368
1906	41,202
1908	33,425
1909	26,125
1910	56,730
1911	98,680
1912	86,240

Thus the catch for 1911 and 1912 far exceeds that of any other two years. The catch for 1911 is confidently stated to have been the best for 20 years. These are very encouraging figures and as the artificial work has of late been on a somewhat larger scale than formerly, the prospect of eventual success is very cheerful.

BUILDING AN AQUARIUM FOR PHILADELPHIA

By W. E. Meehan,
Director of the Philadelphia Aquarium.

After fifteen years of agitation, the City Councils of Philadelphia passed an ordinance directing the establishment of a Public Aquarium. The ordinance was signed by the Mayor, John E. Reyburn, May 16, 1911. By its terms the old Fairmount Water-works buildings in Fairmount Park, near the Spring Garden Street Bridge and on the banks of the Schuylkill River were designated as the site of the new institution.

The Fairmount Water-works were built in the first quarter of the last century, and for many years were famous over this country and Europe for the completeness of the plant and for the beauty of the buildings. They were situated below the Fairmount Dam, with a huge rocky hill, known as Faire Mount, as a picturesque background on the east. The water-works plant was abandoned by the city of Philadelphia in 1910.

There were two power houses, one 200 feet long and 50 feet wide, and the other 100 feet long and 50 feet wide; and these it was proposed to utilize for the new Aquarium. They were admirably adapted for the purpose, requiring no radical structural changes. As the roofs are flat and used as a plaza, by the public, it is a simple matter to install the necessary overhead skylights which are to illuminate the tanks.

It is planned to use the smaller of the two buildings as a sea water house and the larger as a fresh water house, and possibly for sea water fishes also. The two buildings will hold approximately 140 capacious tanks.

A small sum, about $1,500, was appropriated in December, 1911, with which to establish a temporary aquarium of fresh water fishes in the large hall of a building once used for administration purposes by the Water Department at the Fairmount water works. In the general plans for the permanent aquarium this large hall is designated by ordinance of councils to be used for the delivery of public free lectures on aquatic animal life. The building in which the temporary aquarium was installed is unsuited for exhibition purposes, and the tanks available not proper for a good or permanent display of fishes. They had belonged to the State and were used by it at the Expositions of Chicago and St. Louis.

The temporary aquarium was installed by me in three weeks, and it is still in operation and visited by about 6,000 people weekly. The first year of its existence there were over 260,000 visitors. Twenty-seven tanks and about that many species of fresh water fish comprise the exhibit.

No work has been done towards the completion of the permanent aquarium since October, 1912, when the sea water house was within about six weeks of completion. The funds provided for the completion of the sea water house and possibly the fresh water house are embodied in a municipal loan authorized last winter, but which will not be available until about October, 1913, perhaps not then.

The tanks in the sea water house will be made of concrete and the majority of them will be seven feet long each, and one 12½ feet.

Lead lined pipe or hard rubber pipe is almost universally in use for conveying sea water to and from tanks, but lead lined pipe very frequently does not give perfect satisfaction, and hard rubber pipe is exceedingly expensive. After mature deliberation I determined to try the experiment of testing the utility of wood pipe. A four-inch pipe of that material for the supply pipe is now in place, and five-inch wooden pipe for the out-flow will be used, together with terra-cotta.

I can see no reason why wooden pipe should not be as efficient as hard rubber and much better and safer than lead lined pipe. It certainly will not corrode, nor leak, and it has been in successful use for more than 30 years in the oil regions for conveying salt water from the oil wells and it is used almost exclusively in the coal mining regions for conveying mine water impregnated with sulphur.

The sea water house abuts directly on the Fairmount Dam. Owing to the liability of floods from the Schuylkill River it was necessary to raise the floor above the ordinary flood level; therefore in that building there will be but one set of tanks. The fresh water house will have a second tier of tanks making the capacity of that building 110 tanks of large size.

OYSTERS, A DESIRABLE FOOD

BY HENRY C. ROWE, *Groton, Conn.*

The "high cost of living" has become a familiar phrase in recent years, but familiar phrases frequently lose their significance because the public mind notices and remembers only what is novel and recent. But the high cost of living is more than a phrase; it represents a stern fact which to many of us is imperative and to all is certainly a problem of great public concern.

The United States and territories are so vast in their extent and resources that a few years ago it seemed that this country was and would remain the chief source of food, clothing, lumber, fuel and minerals for a large portion of the world, but our doors were opened so wide to the crowded millions of other lands that already consumption in certain lines has increased far beyond production and by wasteful methods, luxurious living and other well-known causes, we are brought face to face with this problem. It will insist upon recognition until we find adequate remedies and adopt them.

Among other items the demand for food is imperative. We all know that food has increased vastly in price. Here are some of the figures within a few years:

	Increase
Fresh eggs	26.1 %
Sirloin steak	59.5 %
Roast beef	63.8 %
Fresh milk	32.9 %
Pure lard	55.3 %
Smoked hams	61.3 %
Round steak	84. %
Creamery butter	33.3 %
Hens	58.1 %
Corn meal	63.7 %
Pork chops	86. %

These figures show that some of these foods have become too expensive for constant or frequent popular use. Fortunately there are other foods just as nutritious, wholesome and palatable as are the more expensive, which a large portion of the population can no longer afford to have.

While other foods have so greatly increased in price, oysters can still be furnished at no higher price than many years ago. This is due to the great extension of the artificial propagation, growing and cultivation of oysters. Then, too, the quality of the oysters furnished to the consumer has greatly improved. The improved methods of cultivation, refrigerating and shipping have been a great benefit to the oyster product and they are now in every way more desirable to the consumer than years ago.

Another great advantage in delivering this product is that the transportation is greatly extended and has become more efficient, so that oysters, either opened or in the shell, can be furnished in perfect condition in all parts of the United States and Canada where the railroads penetrate.

Still another very important feature concerning the oyster industry is the fact that the sensational attacks made within a few years upon the wholesomeness of oysters have been discredited by the highest scientific and official authorities on this continent. Dr. Carl L. Alsberg, Chief of the Bureau of Chemistry at Washington, has given special consideration to this subject and says, "I could wish that the number of dangerous sources of milk supply was as small and that the percentage of pure wholesome milk was as great as the proportion of wholesome, safe oysters that reach our tables," and if his opinion needed any support it might be found in the public utterances of other men of the highest authority upon these subjects, as, for instance, Dr. Earle Phelps, Prof. Sedgwick, Dr. Julius Nelson, Dr. Frederick P. Gorham and others.

The prejudice which was instilled in the minds of many timid people has never extended to those persons who are well informed concerning the oyster industry, but it has influenced many of those who are readily impressed by sensational statements of "food demagogues" and by the lurid headlines of the yellow press.

In the paper which I presented to the International Fisheries Congress in 1908, I called attention to the vastly increasing production of oysters and to the importance of this economical, wholesome and palatable food. Since that time the need of such a substitute for meat has greatly increased and the proof of the wholesomeness of oysters has become conclusive. The prejudice which existed for a time has been shown to have had a most trifling foundation in fact and that so far as life and health are concerned there is far more danger in riding on a railroad train, or in a motor car, or even in walking the street where motor cars abound, than there is in eating oysters every day; also, that oysters are far more wholesome and safe than water or milk. We do not hesitate to use water or milk; we only insist that they shall be kept pure and in perfect condition. That is now all that intelligent people require concerning oysters.

For this reason I ask your aid in placing before the public the facts; that the vast increase of the supply of oysters by reason or their artificial propagation; the improved methods of refrigerating and shipping them, and the wholesomeness, palatability and economy of oysters as food, should commend them as a frequent substitute for those foods which have so greatly increased in price during the past ten or fifteen years.

SUGGESTIONS OF POSSIBLE INTEREST TO THE AMERICAN FISHERIES SOCIETY AND TO FISH COMMISSIONS

By Wm. P. Seal, *Delair, N. J.*

I. Argument in favor of certain modifications of the Fish Protective Laws.

In papers read before the American Fisheries Society, the writer has expressed the opinion that there is not the general sympathy that there should be with the objects of this society, the prevailing sentiment being that the laws enacted for fish protection are inspired largely by anglers wholly in the interest of sport. It is the desire here to call attention to one phase of discrimination embodied in fish protective legislation that from the viewpoint of many persons interested is not only unjust but also unwise since it affects a class of men who might possibly become a valuable auxiliary force in the general interests and progress of fish culture.

There are now in the United States seven aquarium societies with a large membership of men of scientific inclinations, and others are projected. There is a monthly magazine devoted to their pursuits published under their joint auspices by members of the societies.

There is in progress in the United States a *renaissance*, so to speak, in the use of the aquarium as a scientific instrument for nature study. Large numbers of beautiful and interesting species of fishes are constantly being imported from Germany, where they are being bred, to which country they have been brought from remote parts of the earth, but many of them from North, Central, and South America, and even the United States.

The illustrated catalogs of the ornamental fish breeders and dealers of Germany are an astounding revelation of our lack of progress in this direction. In the United States we have a great many beautiful and interesting species, especially adapted to the aquarium, which are not of the slightest value commercially and many of which have no value even as food for the commercial or sport species, but on the other hand are to a greater or less extent destructive to the young of such, and of their food. But, even if they were valuable in some respect or other, the numbers of them that would be taken for scientific purposes—which would properly include aquarium stock—would be relatively so small as to be insignificant. Dr. Theodore Gill once said to the writer, "It is a shame that we know so little of our commonest fishes." And in his paper, "A Plea for the Observation of the Habits of Fishes, and Against Undue Generalization," read before the Fourth International Fishery Congress, he says, "We have still much to learn about our most common and longest known species."

Surely if there is any value in nature study, the observation of our fishes should rank as high as any other phase of it and should receive, at least, encouragement from those most directly interested—the fish culturists and the fishermen. Yet, without a restricted permit, which but few are able to get from the various state fish commissions, an aquarium fancier may not catch a pair of 4-spined sticklebacks for observation, and yet this is one of the most insignificant and absolutely worthless species from any other viewpoint than that of nature study, but from that one of the most interesting. In the State of Pennsylvania the holder of a permit is required to make a report at the end of the year specifying the use he has made of it.

It is apparent from a circular letter recently received from the President of the American Fisheries Society that there is an increasing lack of popular interest in the objects of the society as evidenced by an apparent loss of membership. Many years ago in a paper read before this society the writer outlined a plan of organization tending to popularize the society and the work of fish culture and fish protection. This was merely a suggestion which might or might not have proven practicable, but it was given merely for the purpose of stimulating consideration and discussion of the subject. But it appears to be impossible to overcome the purely selfish tendencies involved and until this is accomplished there will be no progress in this direction.

For many years a stranger listening to the discussions of the American Fisheries Society might have concluded that there was but one phase of fish culture of very great importance, with but one serious question involved, that known as "Fry vs. Yearlings." It will probably never be settled to the satisfaction of its opposing advocates.

It was quite apparent to the writer at the Fourth International Fishery Congress that the feeling was strong among the working fish culturists that too much prominence was being given to scientific and pseudo-scientific investigation, and perhaps even more to plain amateur observations such as interest the writer and others as becomes good citizens interested in problems affecting the general welfare.

The society has since then wisely differentiated its functions thus practically broadening its legitimate field of work, allowing full scope for the spirit of investigation as well as for encouragement of practical work. This course, if pursued with liberality, should lead to greater popularity for the society, without which it never will be progressive.

It is in this spirit and from this viewpoint that it is here suggested that there should be a modification of the fish protective laws in the interest of scientific investigators, nature students, and aquarium fanciers, to allow them to take fishes for their purposes. The schools, even down to the kindergardens, have aquaria, for nature study, but no legitimate means of supplying them.

The aquarium societies represent a class of citizens that should be in alliance and in sympathy with the general work of fish culture and fish protection, if only as creators of fish cultural sentiment. There is no such restriction, so far as known to the writer, in any other country and it is looked upon by those whom it affects as an arbitrary, selfish, and unjust misuse of power. There is no analagous feature in the laws for the protection of birds or quadrupeds. Furthermore, such laws are a dead letter and always will be. But there is no reason why men should have to violate the laws to obtain what they are justly entitled to as well as are a favored few.

The writer is neither a fish culturist nor an angler, and is, of course, unable to comprehend the viewpoint of either, but he believes that a liberal policy on their part is necessary to a progressive development of their interests. Selfishness will not prevail in the future as it has in the past. The writer is not a member of any aquarium society and his personal interest would be opposed to a change in present conditions.

It is, from the writer's viewpoint, unfortunate that the great aquaria of the world would have not been planned in accordance with such principles as would render them of adequate value as aids to biological research. As adjuncts to biological laboratories they have value in the temporary holding of water life under conditions that can never be wholly satisfactory. In the matter of mechanical accessories they may be perfect, but for the actual elucidation by observation of the life histories of fishes they have not the necessary approximation of natural conditions and the results are meagre. They probably afford abundant opportunity for the study of the parasitic forms of life which are developed in greatest profusion under conditions unfavorable to higher forms. But the reports of such institutions show that the general results attained are not what are most desired from an epigenetic viewpoint. The investigations are more likely to be largely pathological than biological.

There is an increased interest in the development of public aquaria. It is, from the writer's viewpoint, unfortunate that the great aquaria of the world have not been planned with a view of making them of value as aids to biological research.* That has been a secondary consid-

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*This is true only of such institutions in the United States. The aquariums of Europe are almost without exception merely adjuncts to biological laboratories. See Kofoid, Biological Stations of Europe, U. S .Bureau of Education, Bull. 4, 1910.—*Editor.*

eration, and whatever knowledge of aquatic life has been gained through them has been by some accidental development of favorable conditions.

It seems to the writer that there should be some way found under Government or other auspices to systematically record such observations in the interest of ichthyology and for the encouragement of a popular interest in fish-culture. Those who have the greatest opportunities do not seem to be able to take advantage of them, but, as a matter of fact, there is little encouragement for it. A reading of "How we encourage research" in "Impressions of Theophrastus Such" (George Elliot) is recommended to all who have scientific aspirations.

The term "rational development" as applied to the establishment of aquaria in this paper means simply the nearest possible approximation to natural conditions, or in other words an endeavor to render fishes measurably contented and happy so that they will continue healthy and perform their natural functions. This we easily do with small species in small aquaria and by simply establishing similar conditions on a large scale we can get the same results with larger species. The writer explained the general principles involved in a paper entitled "The Aqua-Vivarium as an Aid to Biological Research," which was published in the Bulletin of the United States Fish Commission for 1885.

While fully realizing the probable uselessness of making suggestions it is the hope of the writer that some fish-cultural Moses with the wisdom and prescience of a Baird will one day arise and lead in a progressive development of such work. Our present ideals are not beyond those of the ancient Romans—the spectacular. And until we get beyond menagerie methods there will be nothing better. A popular development of the household aquarium will do much to effect a change. Exhibits of bruised, diseased, or half-starved specimens of either land or water life are only disgusting and depressing to a well-balanced mind. Some day public sentiment will condemn exhibitions of animals except in a healthy contented condition.

It appears to have been fairly demonstrated that rod and gun clubs and fish and game protective societies cannot alone be depended on to foster a popular support for progress in fish-culture. Greater liberality and greater publicity such as are revolutionizing the methods of agriculture are what is needed. The present Commissioner of Fisheries has for some years been practically alone in promoting popular publicity—relating to fish culture and fisheries.

The National Geographic Society is an example of what can be accomplished in the building of a society by liberal and efficient management. It has not, like the Fisheries Society, a great economic value to uphold it, but only scientific sentiment, and yet men are proud of the honor of membership in it.

II. Advocating the stocking of the rivers of the Eastern United States with pearl mussels.

Notwithstanding the wide range and extent of the investigations relating to pearl mussel industry by the United States Bureau of Fisheries recording a threatened destruction of the industry through extinction of the mussels, the writer has seen no mention of any movement to stock the waters of the eastern United States with them. East of the Alleghenies are many noble rivers with hundreds of tributaries which should be well adapted to them and which could be easily stocked. The writer has a shell of one of these mussels which he took from the Little Miami River and which is seven inches long and five inches broad with a maximum thickness of about three-quarters of an inch.

It is evident that in pursuing this industry there is a large economic waste that possibly might be prevented by drying the meat of the mussels and grinding it for food for fowls.

The same idea might also be applied to certain marine life that is either wasted or is not taken for want of a market which the poultry industry might possibly supply.

III. Argument in favor of co-ordination of fish culture and protection, conservation of waters, and mosquito extermination.

There are three lines of public work which are at present carried on independently, two of which are as yet only in the first stages of development, which in due course of time it will be found necessary to co-ordinate. These are: 1, fish culture and fish protection; 2, conservation of water supply; and 3, mosquito control, all of which involve problems relating to control of the waters of the country.

President Wilson, when Governor of New Jersey, called attention to the desirability of reducing the number of state boards and commissions in the interests of economy and efficiency. As at present conducted, in many cases, instead of co-operating they work at cross purposes.

Conservation of water supply certainly has a direct bearing both on fish culture and on the mosquito problem, for whatever waters are restored or conserved should be devoted as an economic consideration to the breeding of food fishes. They should therefore be under control of the fish commissions. Having control of the waters, it should be their function to destroy or prevent the breeding of mosquitoes in them.

The basic idea in mosquito extermination is drainage, in some cases, to destroy breeding places, and in others—in tidal regions—to allow the ingress of schools of minnow mosquito destroyers. All this is more or less effective. But it is a question in the mind of the writer whether more consideration should not be given to the possibilities of impounding waters wherever possible instead of resorting to drainage.

It must be apparent to anybody at all familiar with any one of the water sheds in any part of the country that there is an increasing diminution of the flow of springs and small streams as the result of deforestation. This is well understood and our conservation and forestry commissions are striving with all the power that is given them to check this evil. But, already in the State of New Jersey experiments in irrigation are being made, as a result of recurring severe spring and summer droughts affecting the crops.

Would not it then be the part of wisdom to increase by impounding, instead of decreasing by excessive drainage, the extent of our water areas?

It is probable that most of the swamp or marsh land recovered by drainage will never be available for cultivation, or only at excessive cost, while if made into ponds and lakes wherever economically possible, it would provide increased means of adding to our fish food supply as well as additional opportunity for pleasurable recreation and sport.

It is well known that mosquitos are not bred in the larger bodies of water where there are numerous fishes to destroy their larvae. It is the insignificant puddles and pools—the rain pool in particular—that supply them. And this is the case even on the salt marshes. And these insignificant places are very difficult to destroy. In a swampy, boggy place small quantities of water are always present no matter how much draining is done. It will bubble up from springs, the tracks of a cow, horse, or a man will fill, especially after heavy rains, and as it requires only five days to produce a crop of mosquitos the chance of absolutely exterminating them is small, and the work of keeping them in check must, under such conditions, go on continuously and permanently.

These are questions that might profitably be discussed by the American Fisheries Society, for if it is desired to add to its importance and popularity it must necessarily interest itself in whatever practical questions arise, with regard to the waters, that may have a bearing on the general welfare.

Otherwise other societies will arise to promote such work, working perhaps at cross purposes with those interested in fish culture. Sooner or later these questions will have to be considered. The question of efficiency as well as utility in public work is growing in importance.

It is absolutely necessary in the interest of increased and economical food production, which is rapidly becoming the most vital of all questions.

Whether it is wiser for this society to anticipate and lead to the controlling of events that are certain to occur at some time in the future or to postpone all consideration of them until opposing forces have grown more powerful is a question worthy of thought.

If, however, the American Fisheries Society is to remain always an association of fish culturists pure and simple, solely dependent for support on the sporadic and ephemeral enthusiasms of rod and gun clubs and the fishery interests, nothing more need be said. The trifling question of dues has no bearing on the possibilities of accomplishment open to this society through a progressive course. Those of the National Geographic Society are no greater. But look at the membership, 200,000 to a few hundreds. Why is it so?

An optimistic outlook might even forecast the gradual evolution of a great "Department of Conservation" in which would be co-ordinated bureaus of "Conservation of Forests and Waters," "Fish Culture, Fish and Game Protection and Fisheries" and "Biological Research," to cover investigations concerning life of economic value or destructiveness.

LISTS OF MEMBERS, 1913—1914

Showing Year of Election to Membership

Honorary Members

The President of the United States, Woodrow Wilson.
The Governors of the several states.
Alabama, Emmet O'Neal.
Arizona, George W. P. Hunt.
Arkansas, George W. Hays.
California, Hiram W. Johnson.
Colorado, Elias M. Ammons.
Connecticut, Simeon E. Baldwin.
Delaware, Charles R. Miller.
Florida, Park M. Trammell.
Georgia, John M. Slaton.
Idaho, John M. Haines.
Illinois, Edward F. Dunne.
Indiana, Samuel M. Ralston.
Iowa, George W. Clarke.
Kansas, George H. Hodges.
Kentucky, James B. McCreary.
Louisiana, Luther E. Hall.
Maine, William T. Haines.
Maryland, Philip L. Goldsborough.
Massachusetts, David I. Walsh.
Michigan, Woodbridge N. Ferris.
Minnesota, Adolph O. Eberhart.
Mississippi, Earl Brewer.
Missouri, Elliott W. Major.
Montana, Samuel V. Stewart.
Nebraska, John H. Morehead.
Nevada, Tasker L. Oddie.
New Hampshire, Samuel D. Felker.
New Jersey, James F. Fielder.
New Mexico, William C. McDonald.
New York, Martin H. Glynn.
North Carolina, Locke Craig.
North Dakota, L. B. Hanna.
Ohio, James M. Cox.
Oklahoma, Lee Cruce.
Oregon, Oswald West.
Pennsylvania, John K. Tener.
Rhode Island, Aram J. Pothier.
South Carolina, Cole L. Blease.
South Dakota, Frank M. Byrne.
Tennessee, Ben W. Hooper.
Texas, O. B. Colquitt.
Utah, William Spry.
Vermont, Allen M. Fletcher.
Virginia, H. C. Stuart.
Washington, Ernest Lister.
West Virginia, Henry D. Hatfield.
Wisconsin, Francis E. McGovern.
Wyoming, Joseph M. Carey.

'08 ANTIPA, PROF. DR. GREGOIRE, Inspector-General of Fisheries, Bucharest, Roumania.
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'02 Joslyn, C. D., Ford Building, Detroit, Mich.

'05 Keesecker, A. G., U. S. Bureau of Fisheries, Erwin, Tenn.
'99 Keil, W. M., Tuxedo Park, N. Y.
'04 Kelly, H. L., Jr., 827 Rivadavia, Buenos Aires, Argentina.

'12 Kemmerich, Joseph, U. S. Bureau of Fisheries, Washington, D. C.
'02 Kendall, Dr. William C., U. S. Bureau of Fisheries, Washington, D. C.
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'00 Kenyon, A. W., Usquepaugh, R. I.
'10 Kilborn, John R., Cape Vincent, N. Y.
'13 Kinney, M. J., 510 Corbett Bldg., Portland, Oregon.
'04 Kisterbock, Josiah, Jr., Aldine Hotel, Philadelphia, Pa.
'04 Kittredge, Benjamin R., Carmel, N. Y.
'13 Knight, H. J., Alaska Packers' Association, San Francisco, Calif.
'10 Kopplin, Philip, Jr., Missouri Fish Commission, Forest Park, St. Louis, Mo.

'03 Lambert, E. C., Amoskeag Mfg. Co., Manchester, N. H.
'03 Lambson, G. H., U. S. Bureau of Fisheries, Baird, Cal.
'11 Land, S. E., Department of Game and Fish, Denver, Colo.
'04 Laumen, Felix A., U. S. Bureau of Fisheries, Mammoth Springs, Ark.
'08 Lay, Charles, Sandusky, Ohio.
'98 Leach, G. C., U. S. Bureau of Fisheries, Yes Bay, via Ketchikan, Alaska.
'12 Leavitt, Percy W., P. O. Box 374, Akron, Ohio.
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'10 Lee, W. McDonald, Commissioner of Fisheries, Irvington, Va.
'10 Lembkey, Walter I., Woodward Bldg., Washington, D. C.
'02 Lewis, Charles E., Chamber of Commerce, Minneapolis, Minn.
'10 Linton, Dr. Edwin, Washington & Jefferson College, Washington, Pa.
'06 Locher, Wm., Kalamazoo, Mich.
'00 Locke, E. F., U. S. Bureau of Fisheries, Woods Hole, Mass.
'12 Loesch, H. C., Colorado Springs, Colo.
'13 Lowell, Carleton W., U. S. Bureau of Fisheries, Fairport, Iowa.
'98 Lydell, Dwight, Michigan Fish Commission, Comstock Park, Mich.
'10 Lydell, Mrs. Dwight, Comstock Park, Mich.

'10 Mabie, Charles H., Maywood, N. J.
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'03 McDougal, J. M., Gunnison, Colo.
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'13 McLain, W. S., Bellefourche, S. Dak.
'12 McReynolds, B. B., Water Superintendent, Colorado Springs, Colo.
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'80 Mallory, Charles, Port Chester, N. Y.
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'98 Marks, H. H., Sault Ste. Marie, Mich.
'98 Marks, J. P., Michigan Fish Commission, Paris, Mich.
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'06 Marty, John M., Minnesota Fish and Game Association, St. Paul, Minn.
'12 Mason, C. C., Hermit, Colo.
'13 Mathewson, E. P., Anaconda, Mont.

'00 Mathewson, G. T., Thompsonville, Conn.
'84 May, W. L., 314 Nassau Block, Denver, Col.
'00 Mead, Dr. A. D., Brown University, Providence, R. I.
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'11 Merrihew, Percy T., Neosho, Mo.
'13 Merrill, Arthur, Wilkinsonville, Mass.
'12 Merrill, Bertram G., Illinois Fish Conservation Society, Hinsdale, Ill.
'99 Merrill, M. E., U. S. Bureau of Fisheries, St. Johnsbury, Vt.
'13 Mershon, W. B., Saginaw, Mich.
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'02 Miller, Frank, Ohio Fish and Game Commission, Put-in Bay, Ohio.
'08 Miller, Frank M., President Board of Commissioners for the Protection of Birds, Game and Fish, 605 Maison Blanche Bldg., New Orleans, La.
'10 Millett, Arthur L., Gloucester, Mass.
'00 Milligan, Dr. J. D., Woods Hole, Mass.
'92 Mills, G. T., Chairman State Fish Commission, Carson City, Nev.
'11 Minch, Harry C., U. S. Bureau of Fisheries, Fairport, Iowa.
'10 Miner, Roy W., American Museum of Natural History, New York City.
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'13 Monroe, Wm., Comstock Park, Mich.
'13 Moore, Alfred, 618 American Bldg., Philadelphia, Pa.
'99 Moore, Chas. H., Detroit, Mich.
'04 Moore, Dr. H. F., U. S. Bureau of Fisheries, Washington, D. C.
'05 Morcher, George, London, Ohio.
'10 Morgan, Wm. E., U. S. Bureau of Fisheries, Edenton, N. C.
'92 Morrell, Daniel, Hartford, Conn.
'10 Morrill, J. P., Verdi, Nev.
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'99 Morton, W. P., Providence, R. I.
'10 Moser, Captain Jefferson F., General Superintendent Alaska Packers' Association, San Francisco, Cal.
'08 Mowbray, Louis L., New York Aquarium, New York City.
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'13 Murphy, C. H., Sabattis, N. Y.
'12 Musgrove, W. E., Leadville, Colo.

'13 Neal, Walter I., Maine Fish and Game Commission, Augusta, Me.
'73 and '10 Neidlinger, Philip, 2225 Emmons Ave., Sheepshead Bay, N. Y.
'08 Nesley, Charles H., Copake, N. Y.
'86 Nevin, James, Superintendent Wisconsin Fish Commission, Madison, Wis.
'12 Newcomb, William, Tenafly, N. J.
*'07 Newman, Edwin A., President Aquarium Fisheries Co., 4305 8th St., N. W., Washington, D. C.
'13 Newport Free Library, Newport, R. I.
'13 Newport Historical Society, Newport, R. I.
'10 Nicoll, Donald, 145 Bowery, New York City.

'10 NICHOLS, JOHN TREADWELL, American Museum of Natural History, New York City.
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'97 O'BRIEN, W. J., Supt of Hatcheries, Nebraska Game and Fish Commission, Gretna, Neb.
'13 OFTHSUN, T. O., Secy. Minnesota Fish and Game Commission, Glenwood, Minn.
'11 OGELVIE, E. L., Secy. Minnesota State Game and Fish Commission, South St. Paul, Minn.
'95 OHAGE, DR. JUSTUS, St. Paul, Minn.
'13 O'HARA, JOSEPH, Pleasant Mount, Pa.
'00 O'MALLEY, HENRY, U. S. Bureau of Fisheries, Oregon City, Ore.
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'12 OTIS, SPENCER, Railway Exchange, Chicago, Ill.

'13 PAGE, W. H., Sealshipt Oyster Co., Boston, Mass.
'12 PALMER, MARSHALL G., 96 East Ave., Kankakee, Ill.
'04 PALMER, DR. THEODORE S., United States Department of Agriculture, Washington, D. C.
'04 PARKHURST, HON. C. FRANK, Providence, R. I.
'07 PATCHING, FRED, Loring, Alaska.
'11 PATRICK, W. E., Supt. of State Fish Hatcheries, Denver, Colo.
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'02 PAXTON, THOMAS B., Board of State Fish and Game Commissioners, Cincinnati, Ohio.
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'10 PEW, JOHN J., Gloucester, Mass.
'09 PFLEUGER, J. E., Akron, Ohio.
'12 PIERCE, HENRY L., Colorado Fish and Game Commission, Denver, Colo.
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'04 POPE, T. E. B., Milwaukee Public Museum, Milwaukee, Wis.
'06 PORTER, RICHARD, Board of State Fish Commissioners, Paris, Mo.
'09 POSTAL, FRED., State Board of Fish Commissioners, Detroit, Mich.
'12 POTEET, L. A., Deputy Warden, Florence, Colo.
'09 POWER, D. H., President State Board of Fish Commissioners, Suttons Bay, Mich.
'10 POWER, MRS. D. H., Suttons Bay, Mich.
'08 PRATT, DR. JOSEPH HYDE, State Geologist, Chapel Hill, N. C.
'10 PRICE, OVERTON W., National Conservation Association, Colorado Building, Washington, D. C.
'08 PRINCE, PROF. E. E., Dominion Commissioner of Fisheries, Ottawa, Canada.
'13 PURDUM, JAS. K. P., U. S. Bureau of Fisheries, Woods Hole, Mass.

'03 RACE, E. E., U. S. Bureau of Fisheries, Green Lake, Me.
'10 RADCLIFFE, LEWIS, U. S. Bureau of Fisheries, Beaufort, N. C.
'05 RANKIN, J. F., South Charleston, Ohio.
'84 RATHBUN, DR. RICHARD, Assistant Secretary Smithsonian Institution, Washington, D. C.

'93 Ravenel, W. de C., U. S. National Museum, Washington, D. C.
'13 Redwood Library, Newport, R. I.
'09 Reed, Dr. H. D., Cornell University, Ithaca, N. Y.
'12 Reeme, E. W., Leadville, Colo.
'13 Reidel, F. K., Pleasant Mount, Pa.
'93 Reighard, Prof. Jacob E., University of Michigan, Ann Arbor, Mich.
'13 Reynolds, Jas. A., U. S. Bureau of Fisheries, Woods Hole, Mass.
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'13 Rose, W. G., Grand Lake Stream, Me.
'98 Rosenberg, Albert, Kalamazoo, Mich.
'11 Rote, E. E., U. S. Bureau of Fisheries, Homer, Minn.
'10 Rowe, Henry C., Groton, Conn.
'11 Ruckman, Chas. W., U. S. Bureau of Fisheries, Homer, Minn.
'09 Runion, H. P., Bankleman, Neb.
'13 Russell, J. R., U. S. Bureau of Fisheries, Birdsview, Wash.
'13 Ryan, Calvin D., U. S. Bureau of Fisheries, Concrete, Wash.

'13 Sachs, Jas. G., Pres. Kentucky Game and Fish Commission, 6th and Jefferson Sts., Louisville, Ky.
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'05 Salmon, Alden, South Norwalk, Conn.
'13 Santa Barbara Public Library, Santa Barbara, Calif.
'12 Schaeffle, Ernest, Secretary California Fish and Game Commission, San Francisco, Cal.
'13 Schleicher, R. O., Supt. State Fish Hatchery, Story, Wyoming.
'13 Schwartz, Benjamin, Scientific Assistant, U. S. Bureau of Fisheries, Washington, D. C.
'11 Schmitt, Waldo, U. S. Bureau of Fisheries, Washington, D. C.
'00 Seagle, George A., U. S. Bureau of Fisheries, Wytheville, Va.
'13 Seagrave, Arnold, Woonsocket, R. I.
'10 Seal, Wm. P., Delair, N. J.
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'13 Shellford, Victor E., Associate in Zoology, Chicago University, Chicago, Ill.
'13 Sherwin, Gerald, Lake Delaware, N. Y.
'91 Sherwin, H. A., 100 Canal St., Cleveland, Ohio.

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'03 SIMMONS, WALTER C., Providence, R. I.
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'01 SINGLETON, JAMES H., Woonsocket, R. I.
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'91 SMITH, DR. HUGH M., U. S. Commissioner of Fisheries, Washington, D. C.
'99 SMITH, LEWIS H., Algona, Iowa.
'05 SNYDER, J. P., U. S. Bureau of Fisheries, Bozeman, Mont.
'11 SOUTHALL, JOHN B., U. S. Bureau of Fisheries, Fairport, Iowa.
'12 SPARGUR, ROBERT L., Chief Clerk Colorado Fish and Game Commision, Denver, Colo.
'08 SPEAKS, JOHN C., Chief Warden, Ohio Fish and Game Commission, Columbus, Ohio.
'12 SPENCER, F., Provo, Utah.
'87 SPENSLEY, CALVERT, Mineral Point, Wis.
'12 SPERRY, E. P., 126 South Euclid Ave., Oak Park, Ill.
'10 STACK, F. GEORGE, "Kamp Kill Kare," Raquette Lake, N. Y.
'13 STAPLETON, J. J., Green Lake, Me.
'04 STAPLETON, M. F., U. S. Bureau of Fisheries, Manchester, Iowa.
'00 STARR, W. J., State Board of Fish Commissioners, Eau Claire, Wis.
'03 STEELE, G. F., Cornell, Wis.
'11 STERETT, W. G., State Game, Fish and Oyster Commission, Port Lavaca, Texas.
'03 STEVENS, ARTHUR F., 227 West Grand St., Elizabeth, N. J.
'05 STEVENSON, CHAS. H., 511 Moffat Bldg., Detroit, Mich.
'12 STIVERS, D. GAY, Butte Anglers Association, Butte, Mont.
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'13 THAW, AUGUST B., 1421 Shelby St., Indianapolis, Ind.
'99 THAYER, W. W., U. S. Bureau of Fisheries, Northville, Mich.
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'13 TICHENOR, A. K., Secretary Alaska Packers Assn., San Francisco, Calif.
'13 TIMSON, WM., Vice-President, Alaska Packers Assn., San Francisco, Calif.

'10 Tierney, Jas. N., Roxbury, Vt.
'92 Titcomb, John W., Commissioner of Fisheries and Game, Lyndonville, Vt.
'11 Tongue, Leonard M., U. S. Bureau of Fisheries, Washington, D. C.
*'01 and '12 Townsend, Dr. Charles H., Director New York Aquarium, New York, N. Y.
'13 Trexler, Col. Harry C., Allentown, Pa.
'13 Triggs, Chas. W., 218 N. Canal St., Chicago, Ill.
'99 Tubbs, Krank A., U. S. Bureau of Fisheries, Mammoth Spring, Ark.
'98 Tulian, Eugene A., Conservation Commission, New Court House, New Orleans, La.
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'13 Tuxbury, Chas., Windsor, Vt.
'13 Tyson, Jas. W., Connecticut Fish and Game Commission, Hartford, Conn.

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'10 Viles, Blaine S., Inland Fish and Game Commissioner, Augusta, Me.
'11 Viquesney, J. H., State Game and Fish Warden, Belington, W. Va.
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'12 Vogt, James H., Nevada Fish Commission, Carson City, Nev.
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'96 Walker, Bryant, Detroit, Mich.
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'96 Walters, C. H., Cold Spring Harbor, N. Y.
'98 Ward, Prof. H. B., University of Illinois, Urbana, Ill.
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'01 Wheeler, Charles Stetson, Union Trust Building, San Francisco, Cal.
'04 Whitaker, Andrew R., State Fishery Commission, Phoenixville, Pa.
'96 White, R. Tyson, 320 Bridge Street, Brooklyn, N. Y.
'10 Whitman, Edward C., Canso, Nova Scotia, Canada.
'89 Wilbur, H. O., 235 Third St., Philadelphia, Pa.

'99 WILLARD, CHARLES W., President Inland Fisheries Commission, Westerly, R. I.
'01 WILSON, C. H., Glen Falls, N. Y.
'11 WILSON, J. S. P. H., Chairman, Board of Inland Game and Fish Commissioners, Auburn, Me.
'10 WINCHESTER, GRANT E., Forest, Fish and Game Commission, Bemus Point, N. Y.
'00 WINN, DENNIS, U. S. Bureau of Fisheries, Oregon City, Ore.
'13 WINTER, J. H., Alaska Packers Assn., San Francisco, Calif.
'99 WIRES, S. P., U. S. Bureau of Fisheries, Duluth, Minn.
*'13 WISNER, J. NELSON, Director, Institute de Pesca del Uruguay, Punta del Esto, Uruguay.
*'05 WOLTERS, CHAS. A., Oxford and Marvine Streets, Philadelphia, Pa.
'97 WOOD, C. C., Plymouth, Mass.
'13 WOODS, JOHN P., President, Missouri State Fish Commission, 1st and Wright Sts., St. Louis, Mo.
'11 WORTH, HENRY B., U. S. Bureau of Fisheries, Washington, D. C.
'84 WORTH, S. G., U. S. Bureau of Fisheries, Orangeburg, S. C.
'10 WURZBURG, L., Ketchikan, Alaska.

'09 YERINGTON, EDWARD B., Board of Fish Commissioners, Carson City, Nev.
'10 YOUNG, CAPT. CARL C., 2 Mt. Vernon St., Gloucester, Mass.
'06 YOUNG, CAPT. JOHN L., Atlantic City, N. J.

'99 ZALSMAN, P. G., Comstock Park, Mich.

Recapitulation

HONORARY	75
CORRESPONDING	19
ACTIVE (including 30 life members)	611
TOTAL MEMBERSHIP	705

CONSTITUTION

(As amended to date)

ARTICLE I

NAME AND OBJECT

The name of this Society shall be American Fisheries Society. Its object shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success, and upon all matters relating to the fisheries; the uniting and encouraging of all interests of fish culture and the fisheries, and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II

MEMBERS

Any person shall, upon a two-thirds vote and the payment of two dollars, become a member of this Society. In case members do not pay their fees, which shall be two dollars per year after the first year, and are delinquent for two years, they shall be notified by the treasurer, and if the amount due is not paid within a month thereafter, they shall be, without further notice, dropped from the roll of membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

The President (by name) of the United States and the Governors (by name) of the several states shall be honorary members of the Society.

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

Any library, sporting or fishing club, society, firm or corporation may, upon two-thirds vote and the payment of the regular annual fee, become a member of this Society and entitled to all its publications.

Any person, society, club, firm or corporation, on approval by the Executive Committee and on payment of $50.00, may become a Patron of this Society with all the privileges of a life member, and then shall be listed as such in all published lists of the Society. The money thus received shall become a part of the permanent funds of the Society and the interest alone be used as the Society shall designate.

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, an assistant 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.

In addition to the officers above named there shall be elected annually five vice-presidents who shall be in charge of the following five divisions or sections:

1. Fish culture.
2. Commercial fishing.
3. Aquatic biology and physics.
4. Angling.
5. Protection and legislation.

ARTICLE IV

MEETINGS

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting, or, in default of such action, by the executive committee.

ARTICLE V

ORDER OF BUSINESS

1. Call to order by president.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
    a. President.
    b. Secretary.
    c. Treasurer.
    d. Vice-Presidents of Divisions.
    e. Standing committees.
5. Committees appointed by the president.
    a. Committee of five on nomination of officers for ensuing year.
    b. Committee of three on time and place of next meeting.
    c. Auditing committee of three.
    d. Committee of three on programme.
    e. Committee of three on publication.
    f. Committee of three on publicity.
6. Reading of papers and discussion of same.
    (Note—In the reading of papers preference shall be given to the members present.)
7. Miscellaneous business.
8. Adjournment.

ARTICLE VI

CHANGING THE CONSTITUTION

The constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting, provided at least fifteen members are present at said regular meeting.

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