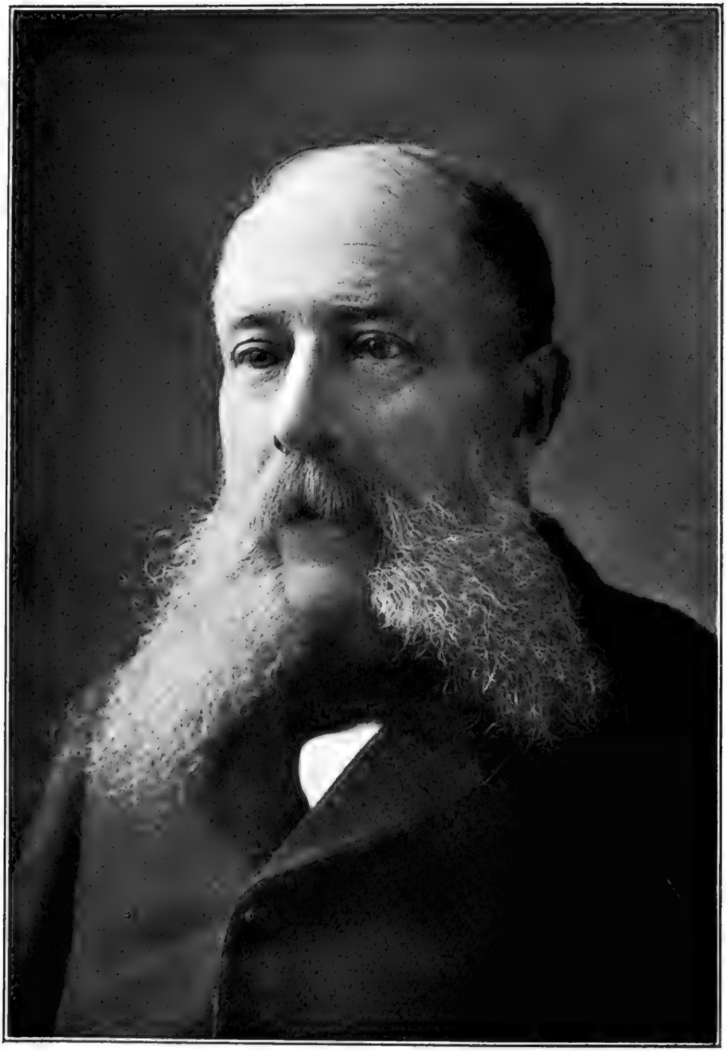
TRANSACTIONS OF THE AMERICAN FISHERIES SOCIETY

1910



Livingston Stone

PIONEER AMERICAN FISH CULTURIST

Only Living Founder of the Society and its First Secretary

Born October 21, 1836

TRANSACTIONS

OF THE

AMERICAN FISHERIES SOCIETY

AT ITS

FORTIETH ANNUAL MEETING

SEPTEMBER 27, 28, AND 29, 1910

AT

NEW YORK CITY

WASHINGTON
PUBLISHED BY THE SOCIETY
1911

W. F. ROBERTS COMPANY
WASHINGTON, D. C.

Officers

1909—1910

Elected at the Thirty-ninth Annual Meeting in Toledo, Ohio, July 27-28, 1909, for the ensuing year, including the Fortieth Anniversary Meeting held in New York City, September 27, 28, and 29, 1910.

President......................... SEYMOUR BOWER, Detroit, Mich.
Vice-President..................... W. E. MEEHAN, Harrisburg, Pa.
Recording Secretary .... GEORGE F. PEABODY, Appleton, Wis.
Assistant Recording Secretary..... WARD T. BOWER, Washington, D. C.
Corresponding Secretary ...... CHARLES G. ATKINS, East Orland, Me.
Treasurer........................... C. W. WILLARD, Westerly, R. I.

Executive Committee

S. F. FULLERTON, *Chairman*, St. Paul, Minn.; CHARLES H. TOWNSEND, New York City; G. H. LAMBSON, Baird, Cal.; GEO. T. MATHEWSON, Thompsonville, Conn.; FRANK MILLER, Put-in Bay, Ohio; JABE ALFORD, Madison, Wis.; C. H. STEVENSON, Detroit, Mich.

1910—1911

Elected at the Fortieth Anniversary Meeting in New York City for the following year, including the meeting to be held in St. Louis, Mo., beginning October 3, 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

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Aquatic Biology and Physics. BARTON W. EVERMANN, Washington, D. C.
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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.

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.

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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

Papers and Discussions:

PAPERS AND DISCUSSIONS—Continued.

LIST OF ILLUSTRATIONS

PART I

BUSINESS SESSIONS

Transactions of the American Fisheries Society

Fortieth Anniversary Meeting, New York Aquarium and the American Museum of Natural History, New York City, Tuesday, Wednesday, and Thursday, September 27, 28 and 29, 1910.

Tuesday, September 27, 1910

Meeting called to order at the Aquarium by the President, Mr. Seymour Bower, at 10 a.m.

PRESIDENT: Gentlemen of the Society, the time having arrived for convening the meeting, you will please be in order.

In opening this fortieth anniversary meeting of the American Fisheries Society I find that it will not be necessary to refer in any way to its organization and history, its inception, growth and vicissitudes, for the reason that a paper touching on these points has been prepared by another and will be read during one of the sessions.

I am pleased and proud to say that this Society is warranted in extending congratulations to itself for the large opening attendance, and more especially for the feast of good things in store, for which a glance at the program should give you a keen appetite. Perhaps my reference to the large attendance may be considered a fish story by those who are with us for the first time and have attended national meetings of other associations that have attracted delegates by the thousands, but I will say that I attended a meeting of this Society not more than twelve or fifteen years ago when an amendment to our constitution, which requires a two-thirds vote to change the dotting of an *i* or the crossing of a *t,* was carried by ten affirmative votes.

However, in this case I do not believe that history will repeat itself because it seems inevitable, as time goes on, that the actual value, and more especially the potential value, of our fisheries will come more and more to be appreciated and recognized; and this naturally will add to the growth and influence of the pioneer national organization devoted to these interests.

Fortunately for me, and I think, for the rest of you, the long list of papers and addresses necessitates brevity on my part, and I will therefore take but a few minutes in presenting some very general thoughts on a timely subject.

The President then read an address on "Fishery Conservation," which appears elsewhere in this report.

PRESIDENT: It seems peculiarly fitting that the fortieth anniversary meeting of this Society should be held in this great city, its birthplace, and especially appropriate that we should convene in this building which was the first great permanent institution in America for the exhibition of live fish.

It is equally fitting and appropriate that we should be welcomed to this city by one of its distinguished citizens, a man of wide experience in practical and scientific fish culture, one who has made the study of fishery problems his life work. I esteem it a privilege to be permitted to introduce to you the director of this aquarium and the acting director of the American Museum of Natural History, Dr. Charles H. Townsend, of New York City.

DR. CHARLES H. TOWNSEND: Members of the American Fisheries Society, I am glad to have the privilege of welcoming you to New York for the fortieth annual meeting of this Society. The period which is included between the founding of this Society and the present time includes practically the first attempt at fish culture and the final successful establishment of such work in this country. The achievements of American fish culture are inseparably connected with the experiments and the successes of members of this

Society. The oldest members have nearly all passed away, and there are but few who were members twenty-five years ago, but the organization lives and thrives. Its present membership of over six hundred includes most of the professional fish culturists of the country, the men who are today conducting our remarkable national and state work of fish propagation and who have for many years contributed to its wonderful success in America, a fish-cultural work unequaled in any other country.

I congratulate this organization on its long and useful life. Its strength is not likely to wane or the art which it has promoted to decline. Its field of usefulness grows with the population of the land, and its labors contribute to the food supply and the general welfare of its people. Let us hope that this will be the best meeting in the history of this Society.

You are invited to lunch today with the trustees of the New York Zoological Society, and with the trustees of the American Museum of Natural History tomorrow, and to make yourselves at home in the aquarium and the museum.

My haste in reducing a very long paper to comparatively few pages may leave it just a trifle disconnected in places, but I will try not to take more than about fifteen minutes of your time.

Dr. Townsend's paper on "The Conservation of Our Rivers and Lakes" was then presented; it is published in full elsewhere.

President: I think you will all agree with me that Dr. Townsend has given us a splendid paper. He seems to have grasped the entire situation.

Our constitution provides the order of business and next is the roll-call of members. This is usually done by having each one sign a card. The cards will be passed to you now. Those who have not already signed will please do so, because only those who fill out a card will be entitled to a badge, and only those who have a badge can get in on the good luncheon this noon. (Laughter.)

REGISTERED ATTENDANCE

The registered attendance at the meeting was 83, as follows:

ALFORD, JABE, Madison, Wis.
AVERY, AMOS W., Greenwich, Conn.
BABBITT, J. O., North Dighton, Mass.
BALLARD, S. THRUSTON, Louisville, Ky.
BEAN, DR. TARLETON H., New York City.
BERKHOUS, J. R., Torresdale, Pa.
BOARDMAN, W. H., Central Falls, R. I.
BOWER, SEYMOUR, Detroit, Mich.
BOWER, WARD T., Washington, D. C.
BRACKETT, J. W., Augusta, Me.
BRIGGS, DR. BENJ. M., Brooklyn, N. Y.
BRYAN, WM. ALANSON, Honolulu, H. T.
BUCK, W. O., Neosho, Mo.
BULLER, A. G., Union City, Pa.
BULLER, N. R., Pleasant Mount, Pa.
BULLER, WM., Corry, Pa.
BUMPUS, DR. H. C., New York City.
CARTER, E. N., St. Johnsbury, Vt.
CASSELMAN, E. S., Dorset, Vt.
CHRISTMAN, AUGUST, Brooklyn, N. Y.
CLARK, FRANK N., Northville, Mich.
COBB, EBEN W., St. Paul, Minn.
COKER, DR. ROBERT E., Fairport, Iowa.
CORLISS, C. G., Gloucester, Mass.
DEAN, DR. BASHFORD, New York City.
DONAHUE, JAMES, Rockland, Me.
DOWNING, S. W., Put-in Bay, Ohio.
DRISCOLL, J. A., Erie, Pa.
DYCHE, LEWIS LINDSAY, Lawrence, Kan.
EVANS, BARTON D., Harrisburg, Pa.
EVANS, KELLY, Toronto, Canada.
EVERMANN, DR. BARTON W., Washington, D. C.
FEARING, DANIEL B., Newport, R. I.
FENN, E. HART, Wethersfield, Conn.
FIELD, DR. GEORGE W., Boston, Mass.
FIELD, PROF. IRVING A., Westminster, Md.
FOLLETT, RICHARD E., Pittsfield, Mass.
FORBES, PROF. S. A, Urbana, Ill.
FOWLER, KENNETH, New York City.
FULLERTON, SAMUEL F., St. Paul, Minn.
GEER, E. HART, Hadlyme, Conn.
GILL, DR. THEODORE, Washington, D. C.

Goodwin, H. D., Milwaukee, Wis.
Gunckel, John E., Toledo, Ohio.
Haas, Wm. F., Spruce Creek, Pa.
Hahn, E. E., Boothbay Harbor, Me.
Hamberger John, Erie, Pa.
Hartman, Phil H., Erie, Pa.
Herrick, Dr. W. P., New York City.
Hurlbut, H. F., East Freetown, Mass.
Hussakof, Dr. Louis, New York City.
Jennings, G. E., New York City.
Johnson, R. S., Washington, D. C.
Keil, W. M., Tuxedo Park, N. Y.
Leach, Glen C., Put-in Bay, Ohio.
Lydell, Dwight, Comstock Park, Mich.
Lydell, Mrs. Dwight, Comstock Park, Mich.
Marsh, M. C., Washington, D. C.
Mathewson, Geo. T., Thompsonville, Conn.
May, William L., Denver, Colo.
Meehan, W. E., Harrisburg, Pa.
Miner, Roy W., New York City.
Morton, Wm. P., Providence, R. I.
Mowbray, Louis L., Hamilton, Bermuda.
Neidlinger, Philip, Sheepshead Bay, N. Y.
Nevin, Jas., Madison, Wis.
Nichols, John T., New York City.
Nicoll, Donald, New York City.
Osburn, Dr. Raymond C., New York City.
Palmer, Dr. T. S., Washington, D. C.
Power, D. H., Suttons Bay, Mich.
Power, Mrs. D. H., Suttons Bay, Mich.
Rickeman, G. W., Madison, Wis.
Robinson, Robert K., White Sulphur Springs, W. Va.
Safford, W. H., Conneaut Lake, Pa.
Sherwood, Geo. H., New York City.
Slade, Geo. P., New York City.
Titcomb, John W., Lyndonville, Vt.
Townsend, Dr. C. H., New York City.
Walters, C. H., Cold Spring Harbor, N. Y.
Whitaker, Andrew R., Phoenixville, Pa.
White, R. Tyson, Brooklyn, N. Y.
Willard, Charles W., Westerly, R. I.

Among the visitors in attendance at the meeting were: Prof. H. F. Osborn, President American Museum of Natural History, New York City; Mr. William Dutcher, President National Association of Audubon Societies, New York

City; Mr. William S. Franklin, South Bethlehem, Pa., and Mrs. S. A. Forbes, Urbana, Ill.

NEW MEMBERS

PRESIDENT: The next order of business is receiving applications for membership, and I will ask the Assistant Secretary to read the names of those who have applied for membership since the last meeting. The Assistant Secretary will act as Secretary during the present meeting.

ACTING SECRETARY: There are at hand 139 applications for membership received since the last meeting, as follows:

ACKLEN, JOSEPH H., Department Game, Fish and Forestry, Nashville, Tenn.
AITCHISON, W. W., 5 Wabash Ave., Chicago, Ill.
ANTHONY, A. W., 686 Overton St., Portland, Ore.
ASBURY PARK FISHING CLUB, care of JOHN F. SEGER, 703 Cookman Ave., Asbury Park, N. J.
AUGUR, W. A., 33 Fulton St., New York City.
AVERY, AMOS W., 47 Arch St., Greenwich, Conn.
BABBITT, JOHN O., North Dighton, Mass.
BACON, CHAS. R., Chief State Bureau of Shell Fisheries, Camden, N. J.
BALLARD, S. THRUSTON, Louisville, Ky.
BARNES, ORLANDO F., Roscommon, Mich.
BARRON, JAMES T., 405 Wells Fargo Building, Portland, Ore.
BASS, SEYMOUR S., U. S. Bureau of Fisheries, Baird, Cal.
BISEMEIER, J. S., 1304 Hartford Building, Chicago, Ill.
BOEPPLE, J. F., U. S. Bureau of Fisheries, Fairport, Iowa.
BOTHWELL, WM. J., Seattle, Wash.
BOYD, JOHN L., Wah Hoo Club, Dallas, Texas.
BRACKETT, J. W., Chairman Board of Inland Fish and Game Commissioners, Augusta, Me.
BRADLEY, GEORGE J., Minnesota Game and Fish Commission, St. Paul, Minn.
BRAMHALL, J. W., 415-417 East Eighth St., Kansas City, Mo.
BRIGGS, DR. BENJ. M., 106 Willoughby St., Brooklyn, N. Y.
BROWNE, THOMAS H., Rutland, Vt.
BRUCE, THOMAS H., 56 Ash St., Waltham, Mass.
BRYAN, PROF. WM. ALANSON, College of Hawaii, Honolulu, H. T.
BUSCHMANN, C. H., General Superintendent Northwestern Fisheries Co., 512 Lowman Building, Seattle, Wash.

CALLAWAY, W. A., care Armour & Co., Brook and Main Sts., Louisville, Ky.
CAVANAUGH, W. T., Olympia, Wash.
CHICHESTER, DR. H. D., U. S. Bureau of Fisheries, Washington, D. C.
CHRISTMAN, AUGUST, 107 Bushwick Ave., Brooklyn, N. Y.
CHRYSTIE, PERCIVAL, Fish and Game Commissioner, High Bridge, N. J.
CHURCH, N. B., Tiverton, R. I.
CLARKE, ISAAC H., Treasurer Inland Fisheries Commission, Jamestown, R. I.
COLLAR, MISS MILDRED A., 27 Rhode Island Ave., Newport, R. I.
CORAYER, MANUEL S., 354 Ash St., Brockton, Mass.
CRAMPTON, PROF. HENRY EDWARD, American Museum of Natural History, New York City.
CRANSON, SAMUEL E., U. S. Bureau of Fisheries, Northville, Mich.
CRANSTON, C. K., care First National Bank, Pendleton, Ore.
CURTIS, CHARLES E., care City Bank, New Haven, Conn.
CUT-OFF FISHING AND HUNTING CLUB, INC., Brunswick, Mo.
DARRAH, THOS. M., P. O. Box 726, Wheeling, W. Va.
DAVIS, THOMAS C., Hampton, Va.
DEAN, DR. BASHFORD, Columbia University, New York City.
DEGROFF, WILLIAM, Board of Commissioners State Bureau of Shell Fisheries, Keyport, N. J.
DONAHUE, JAMES, Commissioner of Sea and Shore Fisheries, Rockland, Me.
DOSSMANN, LAURENT J., President Oyster Commission of Louisiana, 611 Maison Blanche Building, New Orleans, La.
DYCHE, PROF. LEWIS LINDSAY, State Fish and Game Warden, Lawrence, Kan.
EATON, HOWARD, Wolf, Wyo.
EBERLY, H. B., Womelsdorf, Pa.
FENN, E. HART, Commissioner of Fisheries and Game, Wethersfield, Conn.
FIELD, PROF. IRVING A., Western Maryland College, 182 W. Main St., Westminster, Md.
FORBES, PROF. S. A., University of Illinois, Urbana, Ill.
FOSTER, FREDERICK J., U. S. Bureau of Fisheries, Neosho, Mo.
FOWLER, C. F., Waterloo, Iowa.
FOWLER, KENNETH, 1 Fulton Market, New York City.
FROST, EDWARD I., Asheville, N. C.
FULLER, ALFRED E., U. S. Bureau of Fisheries, Northville, Mich.
GAGLE, W. H., Middlesboro, Ky.
GALPIN, HOMER K., 148 Michigan Ave., Chicago, Ill.
GIBSON, ANTONIUS, Port Monmouth, N. J.
GILBOY, JOHN W., St. Paul, Minn.
GRAHAM, GEORGE H., 141 State St., Springfield, Mass.
GRATER, CHARLES B., U. S. Bureau of Fisheries, Afognak, Alaska.
GREENE, PROF. CHAS. W., University of Missouri, 814 Virginia Ave., Columbia, Mo.

Greenleaf, George W., U. S. Bureau of Fisheries, West Boothbay Harbor, Me.

Haller, J. P., General Manager North Alaska Salmon Company, 110 Market St., San Francisco, Cal.

Hansen, Ferdinand, Russian Caviar Co., 170 Chambers St., New York City.

Hansen, P. H., 446 Commercial National Bank Bldg., Chicago, Ill.

Harvey, Horace H., Harvey, La.

Haynes, Edward M., U. S. Bureau of Fisheries, White Sulphur Springs, W. Va.

Healea, C. F., Superintendent State Hatchery, Anaconda, Montana.

Herrick, Prof. Francis Hobart, Adelbert College, Cleveland, Ohio.

Herrick, Dr. W. P., 56 East 53d St., New York City.

Holder, Chas. F., 475 Bellefontaine Ave., Pasadena, Cal.

Hope, W. D., 9 St. Nicholas St., Montreal, Canada.

Hopper, George L., U. S. Bureau of Fisheries, Baird, Cal.

Hunt, W. T., West Chester, Pa.

Hussakof, Dr. Louis, American Museum of Natural History, New York City.

Jordan, Dr. David Starr, Stanford University, Cal.

Kilborn, John R., Cape Vincent, N. Y.

Kleine, Henry, Illinois Fish Commission, 208 West Lake St., Chicago, Ill.

Kopplin, Philip, Jr., Missouri Fish Commission, Forest Park, St. Louis, Mo.

Lee, W. McDonald, Commissioner of Fisheries, Irvington, Va.

Lembkey, Walter I., U. S. Bureau of Fisheries, Washington, D. C.

Linton, Prof. Edwin, Washington and Jefferson College, Washington, Pa.

Lydell, Mrs. Dwight, Comstock Park, Mich.

Mabie, Charles H., Maywood, N. J.

Mannfeld, Geo. N., Indianapolis, Ind.

Maxwell, Henry V., Butler, Tenn.

Millett, Arthur L., Gloucester, Mass.

Miner, Roy W., American Museum of Natural History, New York City.

Mitchell, Walter J., Chairman Maryland Shell Fish Commission, LaPlata, Md.

Morgan, Wm. E., U. S. Bureau of Fisheries, Edenton, N. C.

Morgareidge, C. W., Story, Wyo.

Morrill, J. P., Verdi, Nev.

Morse, Wm. R., Manager International Fisheries Company, Tacoma, Wash.

Moser, Capt. Jefferson F., General Superintendent Alaska Packers' Association, San Francisco, Cal.

Munly, M. G., 405 Wells Fargo Building, Portland, Ore.

Neidlinger, Philip, 2225 Emmons Ave., Sheepshead Bay, N. Y.

Nicoll, Donald, 145 Bowery, New York City.

Nichols, John Treadwell, American Museum of Natural History, New York City.

Oglesby, Philip Powell, 1809 Edgmont Ave., Chester, Pa.

Osburn, Dr. Raymond C., Assistant Director New York Aquarium, New York City.

Owen, Thos. H., Muskogee, Okla.

Paige, Charles L., Shasta, Cal.

Perce, H. Wheeler, 911 Security Building, Chicago, Ill.

Pew, John J., Gloucester, Mass.

Pinkerton, J. A., Superintendent State Hatchery, Glenwood, Minn.

Power, Mrs. D. H., Suttons Bay, Mich.

Price, Overton W., National Conservation Association, Colorado Building, Washington, D. C.

Radcliffe, Lewis, U. S. Bureau of Fisheries, Washington, D. C.

Reade, Gen. Philip, Hotel Wadsworth, Boston, Mass.

Richard, E. A., 20 Greene St., New York City.

Rickeman, Geo. W., State Fish and Game Warden, Madison, Wis.

Rider, H. A., Executive Agent, Minnesota Game and Fish Commission, St. Paul, Minn.

Ring, E. E., Inland Fish and Game Commissioner, Augusta, Me.

Roberts, B. H., 1413 New York Ave., Washington, D. C.

Rogers, James B., U. S. Bureau of Fisheries, Boothbay Harbor, Me.

Roggensack, E. J., Lansing, Iowa.

Roquemore, C. H., Montgomery, Ala.

Rowe, Henry C., Groton, Conn.

Saunders, H. P., Roswell, New Mexico.

Schmauss, Leonard W., U. S. Bureau of Fisheries, Leadville, Colo.

Schnoor, Jacob, Belford, N. J.

Seal, Wm. P., Delair, N. J.

Shebley, Frank A., Superintendent Santa Cruz County Hatchery, Brookdale, Cal.

Shields, G. O., 1061 Simpson St., New York City.

Sieurin, P. G., Director Central Swedish Fish Hatchery Co., Kloten, Sweden.

Smith, Miss Ethel M., U. S. Bureau of Fisheries, Washington, D. C.

Smith, Irving Edward, 1532 16th St. N.W., Washington, D. C.

Stack, George, North Creek, N. Y.

Stead, David G., Fisheries Department, Sydney, New South Wales, Australia.

Sword, C. B., New Westminster, British Columbia, Canada.

Sylvester, Richard, Municipal Building, Washington, D. C.

Tierney, Jas. T., Roxbury, Vt.

Van Sicklen, F. W., 36 Spear St., San Francisco, Cal.

Viles, Blaine S., Inland Fish and Game Commissioner, Augusta, Me.

Whitman, Edward C., Canso, Nova Scotia, Canada.

Winchester, Grant E., Forest, Fish and Game Commission, Bemus Point, N. Y.

WURZBURG, L., Ketchikan, Alaska.
YOUNG, CAPT. CARL C., 2 Mt. Vernon St., Gloucester, Mass.

ACTING SECRETARY: In connection with this list I want to pay tribute to Dr. H. M. Smith, of Washington, D. C. It was entirely through his efforts that at least 100 of the new members were secured last winter. He suggested the plan of sending circular letters to various fishery officials, scientists, and others interested in matters pertinent to the Society's work, requesting them to join. The result was fully a hundred new members. (Applause.)

PRESIDENT: It will be seen that we have received names literally from Maine to California and from Honolulu to Sweden. If this keeps on we will have to change our name from the American Fisheries Society to the Fisheries Society of the World. (Applause.)

MR. FRANK N. CLARK, Northville, Mich.: I move that the applicants be elected to membership and that they become members of this Society upon the payment of the fee of two dollars.

Motion seconded and unanimously carried.

PRESIDENT: The persons who have made application for membership in this Society in accordance with the list just read are declared unanimously elected.

There are, I believe, a few announcements to be made by the Secretary.

ACTING SECRETARY: It will be appreciated if those who have papers will turn them over to the Assistant Secretary in order that the list may be checked up. The papers will be handed back for reading later on.

A notice comes to this desk regarding the use of the lantern at the museum. It is requested that anyone who contemplates the use of the lantern communicate with Dr. Osburn, or some member of the local committee at the earliest possible moment.

Attention is invited to the list of new members that will be found posted on the wall near the head of the stairway.

Not all the names appear, as a few have been received since the list was posted.

A number of circulars have been left on the Secretary's desk. Some are issued by the Metropolitan Museum of Arts, while others are from the Central Museum of Brooklyn. There is also a supply of bulletins from the Zoological Society. These are available for any who desire them.

The Anniversary Committee has provided badges which will be distributed at the close of the morning session.

Dr. Townsend: I would like to state that the accommodations for luncheon are ample, and all who are present in the room will be welcomed at the luncheon whether members or not, but it will be well for all to have the badges in order that the caterer may know whom to admit.

It has been found impracticable to have the luncheon served in the Aquarium owing to lack of space. The luncheon will be served some little distance from here, but the members will be conducted there by officers of the Aquarium. We will leave here about quarter to one o'clock.

INCORPORATION OF THE SOCIETY

President: The next order of business is the reports of officers, and the first called for is that of the President.

I have been a member of the Society for many years and have attended a good many meetings, but I have never known of a president making a report. I think that part of the constitution was intended to be purely ornamental, and as I do not want to establish a precedent at this time I will make no report, but informally I will say that last year there was a committee appointed, or arrangements were made, looking toward the incorporation of this Society. The matter was referred, I think, to a committee, of which the incoming president was made chairman.

Since the last meeting I have taken this question up with one of the leading attorneys of Detroit, and he said he would see if we could not incorporate under the laws of the United States by an act of Congress. He thought that would be the most appropriate way, but later advised that this plan would not be feasible. Then the question arose, what state law should we incorporate under? I thought that it was not for me to decide but rather for the Society, because I might want to incorporate under the laws of Michigan and that, of course, would look a little selfish. My own idea is that, if any honor attaches to this point, the great State of Massachusetts or the Empire State would be entitled to it; although if you are going to consider the Middle West then Michigan is strictly in it, for the reason that it has more coast line than any other state in the Union, and its fresh water fisheries are more important than those of any other state. However, this is entirely a matter for the Society to decide. Do you want to take any action at the present time?

Mr. Clark: I remember the circumstances, but I do not remember why it was thought necessary for us to incorporate.

President: It was said that there were certain funds which might be placed to the credit of this Society, a sort of endowment, if the Society were in a position to accept them; and that it should be incorporated, so that we could sue and be sued if necessary.

Mr. Clark: And it was decided to incorporate?

President: Yes.

Mr. Clark: In view of the fact that the Society was founded in New York State, I move that the officers be instructed to have it incorporated this coming year under the laws of that State.

Mr. Samuel F. Fullerton, St. Paul, Minn.: I second the motion. I think it is very appropriate.

President: The motion is that the proper officers are to have this Society incorporate during the ensuing year under the laws of the State of New York. Is there any discussion? I notice a gentleman from Rhode Island, which is the biggest little state in the Union, who seems to want to say something on the subject.

Mr. William P. Morton, Providence R. I.: We are ready to come right in with you. Any assistance called for from Rhode Island will be cheerfully given.

Mr. Charles W. Willard, Westerly, R. I.: We should be glad to have the Society incorporated for the reason that it could then be sued. I might want to sue for advances. (Laughter.)

Mr. E. Hart Fenn, Wethersfield, Conn.: Are there any difficulties in the way of incorporating this Society in the State of New York? Some states have advantages over others in the case of the incorporation of societies of this character. I take it that this is practically a voluntary association. I know that the several states in their acts of incorporation differ considerably. If there are no serious obstacles, I am in favor of New York.

Mr. Clark: It did not occur to me that any difficulties would arise in this organization such as have troubled corporations involving large capitalization. They have, no doubt, favored a state like New Jersey.

Mr. John E. Gunckel, Toledo, Ohio: If the committee should have any serious trouble, let them move to Ohio and I will see that they are taken care of. (Laughter.)

Mr. W. E. Meehan, Harrisburg, Pa.: The laws of Pennsylvania are very simple for corporations of this kind.

Acting Secretary: A perusal of the records of the Society five or six years back will show that this matter has been under discussion several times. An objection was raised on one occasion to incorporating under the laws of a certain state because it was said by Mr. Dennis, a member of the Society, that the laws were much more favorable in other states. Delaware and New Jersey were mentioned as having very favorable laws under which the Society might incorporate.

Mr. Fullerton: I think that refers entirely to money matters, capital stock, etc.

President: We are not likely to be embarrassed in that respect.

MR. CLARK: The motion might be changed.

MR. FENN: I move that this matter be referred to a committee with power to investigate the laws, and, if agreeable to that committee, to incorporate under the laws of the State of New York. I know the question of fees differs in various states. If New York has a high fee it might be advisable to incorporate in a state that has a low fee.

MR. CLARK: Under some state laws it might bother us to invest the funds which, of course, we expect to have.

MR. FENN: It has been suggested to me that in order to incorporate under the laws of the State of New York we must have a central office in New York; also that the majority of the board of directors must be residents of New York.

ACTING SECRETARY: Mr. Dennis said at the Atlantic City meeting, when this matter was up for discussion, that the laws of Delaware were more liberal than those of any other state under which the Society could obtain a charter. The laws of Delaware do not require that the principal place of business shall be within the state.

PRESIDENT: The question is that we incorporate under the laws of New York if found feasible.

MR. CLARK: Otherwise let the officers incorporate where the laws appear most favorable.

MR. FENN: That is the motion.

Seconded and unanimously carried.

PRESIDENT: The next order of business is the report of the Secretary.

The report of the Acting Secretary was then presented as follows:

REPORT OF THE ASSISTANT SECRETARY

To the Officers and Members of the American Fisheries Society:

As the illness that kept our late beloved Secretary Peabody from attending the last meeting of the Society soon after resulted fatally, the duties of the office have been administered by the Assistant Secretary, aside from the period of his absence of some five months in Alaska when Dr. H. M. Smith attended to the affairs of the office until he was suddenly called to Europe, after which, and until the return of the undersigned, matters were well looked after by Miss Ethel M. Smith, of the Bureau of Fisheries, Washington, D. C.

During the year our ranks have been depleted by the grim visitor to the number of seven, as follows:

Enrico H. Giglioli, Florence, Italy. Died Dec. 20, 1909. Elected a corresponding member in 1884.

Geo. F. Peabody, Appleton, Wis. Died Sept. 12, 1909. Elected to membership in 1895.

Charles P. Bennett, Secretary of State, Providence, R. I. Died August 25, 1909. Elected to membership in 1903.

J. Frank Ellis, U. S. Bureau of Fisheries, Washington, D. C. Died April 7, 1910. Elected to membership in 1885.

Charles H. Ferry, 1551 Railway Exchange, Chicago, Ill. Died May 2, 1910. Elected to membership in 1903.

L. B. Spencer, New York Aquarium, New York City. Died April 16, 1910. Elected to membership in 1901.

A. J. Kavanagh, U. S. Bureau of Fisheries, Leadville, Colo. Died March 1, 1910. Elected to membership in 1908.

Since the last meeting there have been three resignations and twenty-five members have been dropped by the Treasurer for non-payment of dues after failure to respond to repeated notice of arrearage. The names of these delinquents as well as deceased members were omitted from the last published membership list, so far as reported up to the time the completed proceedings were received from the printer's hands early in April.

It may have seemed to some that the publication of the report was unduly delayed, but speaking in the absence of Dr. H. M. Smith, chairman of the newly-created publication committee, of which the undersigned was a member, it may be said that as the committee found its duties rather arduous in the matter of carefully revising and editing all of the papers and discussions, and as every possible effort was made to correct and revise the membership list, it was inevitable that the report should be somewhat delayed. It is hoped that the members will appreciate the position and efforts of the committee.

While heretofore the Secretary has had charge of the publication of the Transactions, it is believed that the Society's best interests will be served if the matter of publishing the reports is delegated to a duly qualified committee.

Before the printing of the last report was taken up Dr. Smith secured bids from several responsible firms, and the proposal of the W. F. Roberts Company, Washington, D. C., for 700 copies at $1.50 per page, being the lowest bid received, was accepted. Arrangements were also made by which reprints of papers in the Transactions could be secured by authors.

An extensive campaign for new members was inaugurated by Dr. Smith, acting primarily on behalf of the Fortieth Anniversary Committee, in which work he had the co-operation of the Assistant Secretary. Over 400 circulars accompanied by application blanks and stamped return envelopes, as well as quite a number of personal appeals, were sent to fish and game clubs, fishery officials, scientists, sportsmen, anglers, commercial dealers, and various others soliciting their membership in the Society. Largely as a result of these efforts 113 applications were received during the year. Almost wholly to Dr. Smith belongs the credit of this splendid showing. The full significance of these efforts may be appreciated when it is known that the largest number of applications heretofore reported in a single year was in 1903 when 72 were received.

Not being aware of the existence of any application blank, a form has been prepared of appropriate design, containing among other things a statement of the objects of the Society, the costs of membership, and a request that the applicant state the features of fishery work in which he is most interested.

In order that the Society may issue proper credentials to each individual member, it is recommended that a certificate of membership be granted under seal of the Society. This would lend weight and dignity to our action, which seems wholly lacking at present, and at the same time it should stimulate interest in the Society. A tentative design of a certificate has been prepared which can be taken up at any time desired by the Society.

Another thing that should receive attention is a revival of the Society's seal of three crossed fishes in a circle which also borders the name of the organization. This form of seal was adopted before we took our present name in 1884. In 1897 action was taken to restore the seal, properly amending the title, and in 1898 Secretary Whitaker reported the purchase at a cost of $4.50. The present whereabouts of this seal is unknown.

The following is an inventory of the reports now on hand:

1895	3	1903	2
1896	2	1904	74
1897	2	1905	2
1898	3	1906	110
1899	5	1907	104
1900	5	1908	130
1901	6	1909	110
1902	9		

It is unfortunate that the earlier records have disappeared, and to guard against further losses it is recommended that the Secretary be authorized to have a set of the reports suitably bound so far as they can be secured, and that subsequent Secretaries, who shall be custodians of the records, be held accountable for them. Contributions of reports prior to 1895 would be welcomed should the Society care to take action on this suggestion.

In concluding this report it may be said in view of the scarcity of the early reports, a card index embracing the history of the connection with 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 to $50. Respectfully submitted,

WARD T. BOWER,
Assistant Secretary.

Washington, D. C., September 26, 1910.

PRESIDENT: That part of the report relative to the death of members during the past year will be referred to the Resolutions Committee, which has not yet been appointed. The committee will be asked to present suitable resolutions.

In connection with the mortality list there were two members with whom I had a long and intimate acquaintance and whose death was to me a deep and personal loss. I refer to the late Secretary, Mr. Peabody, and Mr. J. Frank Ellis, with whom I was associated in the United States Fish Commission nearly thirty years ago.

Referring to that part of the report about the absence of the Secretary, I would say that we were somewhat handicapped this year. Our Secretary died, as you know, and the Assistant Secretary, who was in Alaska, placed matters in the hands of Dr. Smith, who in turn was called to Europe. A large part of the Secretary's duties during the summer therefore devolved upon myself although I had very able assistance in the person of Miss Ethel M. Smith, in the office of the Bureau of Fisheries at Washington.

Do you care to take any action on the recommendations with regard to the seal and certificate of membership? Some members would think a great deal of a certificate showing their membership in the Society.

MR. MEEHAN: Would it not be advisable to turn all these matters over to the Resolutions Committee? I think the recommendations made by the Assistant Secretary should be referred to that committee.

Mr. Clark: I think they should be referred to a special committee of three. The Resolutions Committee will be quite busy as it is.

Mr. Meehan: Very well. Mr. Clark's suggestion is satisfactory.

Mr. Clark: Then I move that those portions of the Assistant Secretary's report which have reference to matters of financial bearing be referred to a special committee of three.

Motion seconded and unanimously carried.

President: I will announce this committee along with the others.

Acting Secretary: Perhaps it may be of interest to briefly mention at this point that last winter Dr. Smith looked into the matter of a certificate and we have a form that was submitted by a firm in Washington. The design is appropriate, though rather small. An engraved plate for it would cost something like $75.00, and the striking off of copies from the plate on good paper would be about fifteen cents each.

President: The Secretary will turn these matters over to the chairman of the committee when appointed, and give the committee whatever information he has in regard to the subject.

We will now receive the report of the Treasurer, Mr. Willard.

REPORT OF THE TREASURER

To the American Fisheries Society:

I herewith present my annual report as Treasurer from July 27, 1909, to September 27, 1910.

RECEIPTS

1909.			
July 27.	Balance cash on hand	$292.05	
	Yearly dues and admission fees	643.00	
	Copies of annual reports sold	5.00	
			$940.05

EXPENDITURES

1909.			
July 27.	Sundry expenses at Toledo	$2.26	
Aug. 21.	500 stamped envelopes	10.72	
Sept. 11.	Goodwin & McDermott, stenographers	159.80	
Oct. 21.	Ward T. Bower, Asst. Sec., express	5.75	
Nov. 1.	Ward T. Bower, Asst. Sec., envelopes and letter heads	7.00	
1910.			
Jan. 5.	Marguerite de Claire, stenographer	10.00	
Feb. 3.	W. F. Roberts Co., printing	19.10	
Mar. 2.	W. F. Roberts Co., printing	17.85	
Apr. 12.	Ward T. Bower, Asst. Sec., postage, etc.	58.68	
Apr. 30	W. F. Roberts Co., annual reports	366.65	
May 21.	500 stamped envelopes	10.72	
June 30.	Rubber stamps ($1.13), letter file (.35)	1.48	
Sept. 10.	Raymond C. Osburn, postage	12.00	
Sept. 12.	Irving Press, circulars, etc.	24.00	
Sept. 16.	W. F. Roberts Co., printing	5.25	
Sept. 23.	J. C. Hall Co., receipt books	6.00	
		717.26	
Sept. 27.	Balance cash on hand	222.79	
			$940.05

Respectfully submitted,

Westerly, R. I., Sept. 27, 1910.

C. W. Willard,
Treasurer.

On motion duly seconded the report was accepted and referred to the Auditing Committee.

PRESIDENT: The next order of business is the report of standing committees. Has the chairman of the Executive Committee any report to make?

MR. FULLERTON: I have not had the committee together yet. I expect that we shall meet after adjournment today.

PRESIDENT: Are there any other standing committees ready to report? Has the chairman of the special anniversary committee anything to offer?

It is customary to appoint a committee on papers and this committee is one of special importance at this meeting because we have such a large number of papers and addresses that the reading of some of them must necessarily be omitted, though read by title and published in the proceedings. The Chair is empowered to appoint this committee, and I will therefore name Mr. M. C. Marsh, Dr. Tarleton H. Bean, Mr. John W. Titcomb, and Dr. Raymond C. Osburn.

The other committees will be announced at the afternoon session.

CONSTITUTIONAL AMENDMENT

A few weeks ago I received quite a long letter from Dr. Smith making a number of suggestions, and some of them I think are most excellent, but with some it is too late to take action this year. Among them was one recommending that we amend the constitution and provide for five vice-presidents, each in charge of a group of subjects that are germane to the affairs of this Society. For example, one is to be a vice-president in charge of fish culture and another in charge of protection of fish. I understand that an amendment to the constitution has been prepared embracing the doctor's suggestion, in substance at least, and I would therefore call for the reading of that amendment and will ask that its adoption be moved, which will bring the matter properly before the meeting.

Mr. Clark: Along that line I have caused an amendment to be drawn to Article III of the constitution, which will read as follows:

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.

Mr. Clark: As you well know I had some talk on this subject with you, Mr. President, and I heartily concur in Dr. Smith's idea. Our Society up to the present has not been large like some of the bodies that are now divided into sections; but we are growing and the time is not far distant when a division into sections will become imperative. We have papers sometimes that do not appeal to some of us as practical fish culturists which will appeal to the scientists. Occasionally a scientific paper does not appeal to the fish culturists, but as the Society grows, if we have these different divisions or sections, the various subjects can be so grouped as to be more interesting and beneficial. In addition it is thought that the vice-presidents will endeavor to stimulate interest in their particular subjects, thus causing a larger and better growth of the Society. For instance, the vice-president of fish culture will push his line, the vice-president of biology will push that line, and so on; and as we grow—which we are destined to do—in ten or twenty years from now we will be a Society of perhaps several thousand members, which means much larger meetings. I think it is really necessary that we have the divisions or sections advocated by Dr. Smith. I move the adoption of the amendment.

MR. GUNCKEL: I only see one line in there that would be a difficult problem to define, and that is the vice-presidency of the angling fraternity. I do not think in the American Fisheries Society (and I have been a member of it for twenty years) that you can find a real truthful angler unless you go to the State of Ohio. One of the principal things I would look after is to see that you get someone who when making his official report would do so as a truthful angler. I have listened for twenty years to these scientific propositions; it is only occasionally that I hear of some angler who will tell the truth about the number of fish caught by scientific anglers. We have only one in Ohio, but I will vouch that he is the most truthful man connected with this association. (Laughter and applause.)

PRESIDENT: We who have known Brother Gunckel a good many years will concede that he is highly qualified to fill the position of vice-president of the particular section he has mentioned. We do not want an angler who will tell the truth, and I know he is well qualified to serve because a few years ago he pursued his investigations into fish culture so far that he produced fish on trees. I know this because I saw his picture of a tree with various kinds of fishes dangling from its branches. I know he is eminently qualified for the place, because he is such a splendid fish liar. Ananias would be jealous if he were here. (Laughter.)

DR. BEAN: If Brother Gunckel said fish grow on trees, he was undoubtedly correct, as they certainly do in Alaska. (Laughter.)

MR. WARD T. BOWER: I think neither the professional nor the amateur fish liar should be excluded from membership in this section. (Laughter.)

President: It requires a two-thirds vote to amend the constitution.

Motion was put and unanimously carried amending Article III of the constitution.

Dr. Townsend: I wish to repeat what I said a few moments ago, that we will all assemble in this room at a quarter of one and proceed to the lunch room under the guidance of the officers of the Aquarium.

Recess was then taken until 2 p.m.

At 2.30 p.m. the meeting was called to order by the President.

President: Quite a good many members are not present, but we have so much before us that I do not think we are justified in waiting any longer.

I will announce the following committees:

Committee on Resolutions: J. E. Gunckel, Dr. T. S. Palmer, and R. S. Johnson.

Committee on Nomination of Officers: W. H. Boardman, Dr. T. H. Bean, Frank N. Clark, James Nevin, and S. W. Downing.

Committee on Time and Place of Meeting: Dr. B. W. Evermann, William L. May, and S. F. Fullerton.

Auditing Committee: W. E. Meehan, E. N. Carter, and George T. Mathewson.

Committee to Act on Recommendations of the Assistant Secretary: Dr. H. C. Bumpus, D. H. Power, and R. T. White.

Mr. Meehan: Is not there another committee? Was not a Publication Committee mentioned?

President: Upon reading last year's report you will find that the publication of the proceedings this year is placed entirely in the hands of the Special Anniversary Committee.

Mr. Meehan: I supposed that there was a permanent committee.

President: There is a permanent committee, but its duties as well as those of the Secretary were practically suspended for this particular meeting, and turned over to the Special Anniversary Committee.

MR. MEEHAN: Is not there a committee appointed on the question of the incorporation of this Society?

PRESIDENT: No, that was left to the officers, not to a special committee.

PRESIDENT: The Committee on the Reading of Papers has recommended that we take up the three bass papers; first, Dr. Bean's, then Mr. Meehan's, and then Mr. Lydell's, and discuss them together. The next paper will be read by one of those rare individuals, who is both a scientific and a practical man and who has done splendid work in both directions, Dr. Tarleton H. Bean, of New York.

Dr. Bean then read a paper entitled "Notes on Black Bass."

Mr. W. E. Meehan, Commissioner of Fisheries of Pennsylvania, then read a paper on "Observations on the Small-mouth Black Bass During the Spawning Season of 1910."

PRESIDENT: The next paper is entitled "Increasing and Insuring the Output and Natural Food Supply of Small-mouth Blass Bass Fry, and Notes on Combination of Breeding and Rearing Ponds." This paper which is by Mr. Dwight Lydell, of Comstock Park, Mich., will be read by Dr. Raymond C. Osburn, Assistant Director of the New York Aquarium. I want to say a word about the author of this paper. He undoubtedly has had more practical experience in the hatching of bass, has unquestionably developed more new points concerning the hatching of bass, and has actually hatched more bass than any man in this or any other country. His batting average is always the highest and his fielding is nearly perfect. (Applause.)

Dr. Osburn then read Mr. Lydell's paper.

Full discussion was then had on the three preceding papers.

PRESIDENT: I have not the honor of being acquainted with the author of the paper that follows, although I have corresponded with him. We shall now be pleased to hear from

Prof. Irving A. Field, of Western Maryland College, on "Utilization of Sea Mussels for Food."

Professor Field then read his paper, which was discussed.

PRESIDENT: The gentleman who will read the next paper is an old time personal friend and acquaintance. In fact, we were associated in fish cultural work nearly thirty years ago and he has since risen to a very high position in the Bureau of Fisheries. The paper is on "The Magnitude and Scope of the Work of the United States Bureau of Fisheries, 1910," and is by Mr. R. S. Johnson, Chief of the Division of Fish Culture, United States Bureau of Fisheries, Washington, D. C.

Mr. Johnson then presented his paper.

PRESIDENT: The next paper will be on the subject of "Commercial Trout Hatcheries and Their Influence on Public Hatcheries," by Mr. Eben W. Cobb, Superintendent Minnesota Game and Fish Commission, St. Paul, Minn.

Mr. Cobb then read his paper, which was discussed.

ACTING SECRETARY: I should like to have the indulgence of the Society for a moment to call attention more particularly for the benefit of the Committee on Time and Place of Meeting to invitations that have come to hand from the City of St. Louis. I have here invitations from the Mayor and from the Business Men's League, Merchants' Exchange, Missouri Manufacturers' Association, and the Million Population Club, urging that our next meeting be held at St. Louis.

PRESIDENT: Are there any other invitations?

ACTING SECRETARY: Letters have also been received inviting the Society to meet at New Orleans.

MR. MEEHAN: I have a letter, and, I think, Mr. Clark has a letter, from New Orleans.

PRESIDENT: The Assistant Secretary is directed to turn all these matters over to the chairman of the Committee on Time and Place of Meeting.

PRESIDENT: Dr. Townsend's idea in leaving the evenings open was to give you a chance to see some of the sights of

New York, so that you would all be sure to be on hand when we convene. So please bear in mind that ample time will be given between sessions to see quite a little of New York. We are going to try to rush things through and give you Thursday afternoon for sightseeing. I want to tell you this in advance so that you will be sure and attend all sessions. I have been to a number of meetings of the American Fisheries Society where there were so many outside attractions that it was hard to induce half the members to attend. I trust that this will not be the case at this fortieth annual meeting.

A recess was then taken until 10 a.m. next day.

Wednesday, September 28, 1910

Meeting called to order by the President at the American Museum of Natural History, New York City.

PRESIDENT: As we have a tremendous amount of work to accomplish I will take as little time in preliminary matters as possible. It is with great pleasure that I introduce to you the President of this magnificent institution, Prof. H. F. Osburn, of the American Museum of Natural History. (Applause.)

PROFESSOR OSBORN: Mr. President and members of the American Fisheries Society: It is a great pleasure to welcome you to this institution which is interested in all branches of natural history, and I consider it an honor because the American Fisheries Society leads the world in the matter of its particular purpose, namely, fish culture. I believe that such has been acknowledged since the days of Spencer F. Baird. You will observe in our memorial hall one of the places of honor is given to a portrait of that truly great man, Spencer F. Baird.

First, I would like to say a word in regard to what I hope you will see, namely, that this great city of New York is waking up from its slumbers; it is taking advantage of the wealth and influence in the merchant class to build up its scientific institutions; and although I am speaking as an insider and perhaps should not praise my own city, nevertheless I do feel proud of the progress which has been made in the last ten or fifteen years. This is reflected in the Aquarium which you saw yesterday under what I think you will all recognize as the most able management of Dr. Townsend, and is shown, I think, in this institution which has been under the direction of Dr. Bumpus, and in the Zoölogical Park under the direction of Dr. Hornaday. These three institutions last year had between 6,000,000 and 7,000,000 visitors. They are free every day in the year to the public, and there is no city in the world that now offers the advantages for free education in natural history in its most popular form equal to that of the city of Manhattan, which, I am sorry to say, in some parts of the United States, is still considered as under corrupt rule and the mismanagement of a bad government. Gentlemen, we have not a bad government, we have a good government. (Applause.)

And I will say this for our administrators. They never button up the purse when these institutions come to them and ask for money; for whatever else they may differ about, they are all one on the subject of education.

Now I would like to call your attention within the Museum to certain exhibits which you may otherwise not see in the short time at your disposal. One is the admirable gallery of fishes arranged by Mr. Miner, under the direction of Dr. Bumpus; the other is the beautiful alcove of the extinct fishes of this country, going back to the earliest time of which we have any records of fish life, arranged by Dr. Bashford Dean with the assistance of Dr. Hussakof. This is only a beginning of what the Museum hopes to do in this very important field of life. We propose first to have a hall as large as any of our standard halls which shall be devoted entirely to fish life; secondly, Mr. President, we are now beginning to plan what will be a most important adjunct, that is, a hall devoted to oceanography, to the whole science of the sea; and Sir John Murray, the patron saint of oceanography, has promised to give this plan his heartiest support, and Dr. Townsend has also said that he is ready to serve as honorary curator of that hall whenever it shall be established.

In closing permit me to renew a welcome for myself and the trustees of this institution as well as for all its scientific staff. (Applause.)

PRESIDENT: If there were any doubts as to whether this great city gives proper support to its better class of institutions, I am sure they will be dispelled by the statements and the very able address of the president of this institution.

The Committee on Papers has presented as next in order seven addresses or papers all of which are to be illustrated. Preliminary to the first paper, I want to say just a word.

Nearly thirty years ago, when I was in the employ of the United States Fish Commission, as it was then known, I accompanied one of the distributing cars that was carrying a load of young whitefish from the Government hatchery at Northville to Lake Michigan. After we had deposited the fry in the lake I noticed a man outside rowing up and down and back and forth some little distance out, with something trailing from the stern of his boat. Shortly he came ashore with the trailer, which proved to be a plankton net. That was absolutely the pioneer scientific work in the study of the crustacean life of the great lakes. That gentleman from that day to this has continued his scientific investigations and has produced a large number of very able papers in connection with fisheries problems. I am pleased to say that he is here today and is first on the list. I have great pleasure in introducing to you Prof. S. A. Forbes, director of the State Laboratory of Natural History, Urbana, Ill., who will read a paper on "The Investigation of a River System in the Interest of its Fisheries."

Professor Forbes' paper was then read and discussed.

PRESIDENT: Some men in this world achieve fame, or at least temporary notoriety, by making a big noise and claim-ing everything in sight, but for such as these there is always a day of reckoning; then follows oblivion, because they have contributed nothing of value to future generations or their own, and they are soon forgotten utterly. In pleasing contrast is the other kind, those who move quietly, like a deep and mighty river, typifying power, strength and majesty; and such as these achieve permanent fame, because they earn it and deserve it. To this class belongs an unassuming gentleman, who by honest methods, hard work and strict merit, has placed his name indelibly in the fisheries hall of fame, and I will introduce him to you in the person of Dr. Barton W. Evermann, who will address you on "The Alaska Fisheries Service." (Applause.)

Following this paper, which was discussed, Dr. Evermann gave an account of "An Experiment in Fur-Seal Conservation," which also was discussed.

The next paper will be by Dr. F. B. Sumner, Director United States Bureau of Fisheries Laboratory, Woods Hole, Mass., on the subject of "Adaptive Changes of Color Among Fishes."

Dr. Sumner then read his paper, which was discussed.

Dr. Townsend: The Society is invited to luncheon in Darwin Hall, which is on this floor in the extreme east end. The trustees of the Museum will be very glad to receive all of you. It will be as well for you to show badges so that the Museum attendants may distinguish you.

President: As luncheon will not be served until one o'clock, and as we have a fifteen-minute paper, we can take it up before that time. The subject is "The Spoonbill Fishery of the Lower Mississippi," by Dr. Louis Hussakof, Assistant Curator of Ichthyology, American Museum of Natural History, New York City. Dr. Hussakof's remarks will be illustrated.

Dr. Hussakof's paper was then presented.

President: We will have to omit the discussion of this paper until after luncheon. The Secretary has an announcement.

Acting Secretary: Any members who have not registered are requested to kindly do so at their earliest convenience. I have a supply of the badges referred to by Dr. Townsend a few moments ago in case any are not provided with them.

President: The afternoon session will be held in the large auditorium on the main floor in order that we may have the benefit of the facilities for the motion pictures.

A recess was then taken until 2 p.m.

The Society reconvened and was called to order at 2.30 p.m.

President: When we adjourned for recess Dr. Hussakof had given his talk, but it was not discussed, so the matter is now open for discussion.

Dr. Hussakof's paper was then discussed.

President: The next paper on the list is by Prof. Wm. Alanson Bryan, College of Hawaii, Honolulu, and is entitled "Methods in Aquatic Photography," illustrated with lantern slides and motion pictures.

Professor Bryan then read his paper, which was discussed.

President: We will now proceed with the next paper as arranged by the Program Committee, which will be announced by the Secretary.

Acting Secretary: The next paper is by Mr. John Treadwell Nichols, of the American Museum of Natural History, and is entitled "The Museum's Exhibit of Fishes."

This paper was then read and discussed.

Dr. Townsend: I would suggest that we hear Mr. Follett's paper and then adjourn to the other room.

President: It is understood that at the conclusion of the next paper we will adjourn to the smaller room. The paper will be on "Conservation of Forest Life," by Mr. R. E. Follett, Vice-President and General Manager of the New England Forest, Fish and Game Association, Boston, Mass.

Mr. Follett's lecture was illustrated with moving pictures and was discussed.

President: I do not know how the rest of the members feel about it, but I always enjoy Mr. Follett's lectures and moving pictures. At Washington he gave an entirely different set of pictures, which made a distinct and decided hit. If there are no further remarks we will adjourn to the smaller audience room.

Remember, gentlemen, that we have a lot of work before us, and we must improve every possible moment. I want to call attention to the fact that the gentleman who will read the next paper is really the dean of the American Fisheries Society. He is the oldest living active member, oldest in point of membership. He joined the Society in the year 1875 and we were born in 1870. This gentleman is, as many of you know, perhaps the most eminent ichthyologist in the United States today. He will address you on the subject of "The Natural History of the Weakfish."

Dr. Theodore Gill, Smithsonian Institution, Washington, D. C., then addressed the Society on the subject announced, and the address was discussed.

PRESIDENT: Thirty years ago, when I was in the employ of the United States Fish Commission, I was sent to North Bass Island, Ohio, to make a collection of whitefish eggs. As that was my first year in the business and as I was without experience in that feature of the work, I naturally had some misgivings as to its outcome. However, after landing on the island and talking a few minutes with three men, two of whom later sailed my boat, while the other acted as spawntaker, I was completely reassured, because I saw at once that I was dealing with men of brains and resources. This was amply demonstrated by the fact that within a few years these men who had been working as common fishermen, were superintendents of stations in the United States Fish Commission. I am pleased to state that one of those men who thirty years ago was a fisherman, and who has since become one of the best practical fish culturists in the United States, is with us today in the person of Mr. S. W. Downing, Superintendent United States Fisheries Station, Put-in Bay, Ohio, who has given us a paper entitled

"Some of the Difficulties Encountered in Collecting Pike-Perch Eggs."

Mr. Downing's paper was read by Mr. Meehan and was discussed.

PRESIDENT: The next paper on the program is by Mr. W. H. Safford, Superintendent of the Crawford State Hatchery, at Conneaut Lake, Pa., and is entitled "Some Observations in Frog Culture." At the author's request this paper will be read by the Secretary.

Mr. Safford's paper was then read and discussed.

MR. M. C. MARSH, Washington, D. C.: I should like to inquire, as chairman of the Program Committee, how many papers there are whose authors are present. Before the meeting this morning there were twenty-four papers with authors ready to read them. Owing to absence part of the time I do not know how many you have had today, but I suppose at least a dozen. I do not see how we can get through the remaining papers unless we hold an evening session.

PRESIDENT: Personally I am willing to hold an evening session, but I will guarantee that we cannot get ten people at the Aquarium this evening. It is all in the hands of the Society, however.

MR. FULLERTON: Why could not the meeting be held at the hotel?

PRESIDENT: I do not know whether they have any suitable place there.

DR. TOWNSEND: The hotel has a room at your disposal.

MR. MEEHAN: Many of the members have made other arrangements for the evening.

PRESIDENT: I know of several who have engaged reserved seats. I think Mr. Clark is one of them. (Laughter.)

MR. CLARK: Oh, no. However, I move we adjourn until 9 o'clock, sharp, tomorrow morning at the Aquarium.

The motion was seconded and carried.

PRESIDENT: We will open at 9 o'clock sharp, even if you are not all there.

MR. TOWNSEND: The meeting will be held at the Aquarium?

PRESIDENT: Yes.

Thursday, September 29, 1910

The meeting was called to order at the Aquarium by the President at 9 o'clock a.m.

PRESIDENT: Before taking up the reading of papers this morning it is thought best to transact some business, to the extent that committee chairmen are ready to report. One of the first committees to be called on is that on the recommendations made by the Secretary, and inasmuch as none of the members of that committee are present, and I think two of them are almost certain not to be here, we have referred the matter to Mr. Clark and will call on him to report.

MR. CLARK: Mr. President, I have given the matter some thought and will try to make a report which, I hope, will be satisfactory to the Society.

The Acting Secretary recommends a certificate of membership and a seal. Such a certificate ought to be something that each member will cherish. The Society is very fortunate in that it has a member who has volunteered to donate these articles. Mr. Fearing has kindly offered to stand all expense for a suitable membership certificate. (Applause.) Of course, the committee recommends the acceptance of so generous an offer.

It is further recommended that a set of all back numbers of reports, so far as obtainable, be bound, at a cost not to exceed $25.

As to the matter of the card index that the Secretary suggests in his report, we would like to recommend its adoption, provided we have the money. It is, therefore, recommended that a card index be provided if there are sufficient funds.

I move the adoption of the committee's report.

The motion was seconded.

PRESIDENT: It is moved and seconded that the report on the recommendations of the Assistant Secretary be adopted.

Mr. Daniel B. Fearing, Newport, R. I.: I understood yesterday that the seal of the Society had disappeared, somewhat like the Pope's ring. If we are incorporated we need a new seal, and my offer included a new seal to be made by Tiffany. (Applause.)

Mr. Clark: In my remarks as to Mr. Fearing's offer I meant to include the seal. A plate, of course, will be made for the certificate.

President: The plate and seal are the donation of Mr. Fearing.

Mr. Gunckel: I do not know anything more valuable to us than a certificate of membership. Suppose I was in Missouri and told a fish story that was doubted, I could show my certificate and that would settle everything. (Laughter.)

President: I agree with Mr. Gunckel that all of us need a certificate of membership, except himself. Mr. Gunckel would not need to be identified anywhere. (Laughter.)

The report was thereupon unanimously adopted.

INDEX OF THE TRANSACTIONS

Mr. John W. Titcomb, Lyndonville, Vt.: Is the card index to be a topical index?

Acting Secretary: The principal object is to have references both to members and all subjects coming before the Society. An authors' index has recently been worked up in connection with a history of the Society that I have prepared, but naturally it will not meet future contributions nor does it give references to the wide range of topics embraced in the discussions of papers or during business sessions.

Mr. Titcomb: It does not purport to contain a topical index to all the subjects discussed?

Acting Secretary: It includes only references to authors and papers. The discussions often wandered over a variety of subjects, which, if properly indexed, would mean quite an undertaking.

Mr. Titcomb: I will give my share toward the publication of such an index. I think it is worth a great deal, as it will save much needless repetition. We can look back and see what has been said, and what has been settled will not have to be repeated.

Acting Secretary: One feature of the index I have in mind is a history of each member's connection with the Society, insofar as it can be obtained from the records, including both present and past members.

Mr. Titcomb: Of course, that is desirable for the use of the Secretary, but we ought to have an index, accessible to every member, of the subjects discussed here from time immemorial. I mean that we will take up a discussion on trout and somebody will break off into bass and we get some good meat on bass; but it is absolutely lost for all time after it is buried in the proceedings, unless you pore over the whole thing to get it. Now what I want to see is a topical index of the papers and matter contained in the discussions from the time the Transactions were first published to the present day. I am ready to subscribe my share towards having a card index of that kind prepared.

Acting Secretary: To be in the Secretary's hands?

Mr. Titcomb: I mean an index to be in the Secretary's hands, and when printed have copies for the rest of us, so that each member can have it to file with the Society's reports.

Acting Secretary: That is more elaborate than I at first contemplated.

Mr. Titcomb: We have not time enough to pore over all the Society's publications which at present is necessary if we want to carefully work up a subject. If we have a complete topical index much labor will be saved. Take, for instance, yesterday; we began with Professor Forbes' paper on the Illinois River and landed up in the lumber region of Canada. We want references to show that the discussion included views on the effect of running logs and emptying sawdust into streams. Likewise every time that sawdust is mentioned in connection with the pollution of streams, or in connection with fish culture, it should be card indexed, whether in a discussion or a paper. Then when we desire to read up on some subject or to get information along any one line, our index will show where it is.

ACTING SECRETARY: That is much more elaborate than would come within the scope of an index such as I have prepared.

MR. TITCOMB: Yes, it is a big job.

MR. MEEHAN: Even though it requires much labor to get what Mr. Titcomb suggests, I trust it will be done. I would be willing to join with Mr. Titcomb or anybody else towards defraying the extra expense. I know to my cost the trouble of looking things up. I had to go back on one occasion through every volume of the proceedings in my possession and look over not only the papers but the discussions, because what I wanted oftentimes turned up in discussions on subjects entirely foreign to the matter originally under discussion. A card index which would enable a member to get information on any subject he wants would be exceedingly valuable and I hope it will be prepared.

MR. CLARK: I move you that a committee be appointed, consisting of Mr. Titcomb, the incoming Secretary, and Dr. H. M. Smith, to take this matter of a card index under consideration and report to the Society at its next annual meeting, giving us an estimate of what it will cost.

MR. TITCOMB: Let me amend that motion by putting Dr. H. M. Smith's name first on the committee.

Amendment seconded.

MR. FEARING: I would like to ask where this card index is to be kept?

PRESIDENT: The records are to be kept with the Secretary, and, as suggested by Mr. Titcomb, a sufficient number of copies can be published so that each member may have one.

MR. FEARING: On account of the impossibility of making additions, a printed index is of much less value than a card index. But if the card index is kept in the Secretary's office it seems to me that the only thing necessary would be to write to the Secretary and state the subject in which you were interested, and get him to furnish references from the card index to the volumes and transactions containing the desired information. I have a library of 10,000 volumes and am only half way through a card index of it.

MR. MEEHAN: It would be perhaps better to change from a card index to a reference index.

MR. FEARING: I think a reference index is needed. A card index that is kept up to date cannot be printed on account of constant additions.

PRESIDENT: I think Mr. Fearing is right. The matter of printing was my conclusion from what Mr. Titcomb said.

MR. TITCOMB: I would rather have it in card form. You can keep it up to date by printing cards every year, and all could get copies of the cards. But probably it would be in the interests of economy to have a simple topical detailed index. Every time fry versus fingerlings is discussed I want the index to show it.

DR. BASHFORD DEAN, New York City: Will the index refer exclusively to the publications of the Society?

MR. CLARK: That is the aim of my motion. We have proposed a perfectly capable committee that will, no doubt, correspond with Mr. Fearing and others and get their ideas before formulating a report for our next meeting. They have a whole year in which to determine what ought to be done.

MR. FEARING: I possess a complete set of the Transactions of this Society, lacking the first five numbers, and those Transactions are now being indexed in the way Mr. Titcomb suggests.

MR. TITCOMB: Good!

MR. FEARING: It will be a matter of perhaps two or three months before I can have it printed, and when it is finished I shall be very glad to have a sufficient number of copies prepared to send one to each member of the Society.

(Applause.) I would like to say that if anybody can put me in the way of getting the first five volumes of the Transactions I shall be willing to pay anything in reason for them.

Mr. Clark: I move that Mr. Fearing be added to this committee, if he will kindly serve.

Dr. Dean: I move that a vote of thanks of the Society be extended to Mr. Fearing for his kind offer.

President: We will now take up the amendment to add Mr. Fearing to the committee.

Seconded and carried.

The motion to extend a vote of thanks to Mr. Fearing was seconded and unanimously carried.

The amendment of Mr. Titcomb to put Dr. Smith at the head of the committee instead of himself was seconded and carried.

President: The question is now on the original motion as amended, making Dr. Smith chairman of the committee, the Secretary as one of the members, and Mr. Titcomb and Mr. Fearing as the other members.

The motion was unanimously carried.

ELECTION OF OFFICERS

President: We will now receive the report of the Committee on Nominations.

Mr. Boardman: The Committee on Nominations has gone over the subject thoroughly and suggests the following for the general officers of the Society for the coming year:

President, Mr. William E. Meehan, Harrisburg, Pa.

Vice-President, Mr. Samuel F. Fullerton, St. Paul, Minn.

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, Westerly, R. I.

In the selection of the Vice-Presidents to take charge of the proposed divisions the committee had considerable trouble in reaching a decision, not on account of the lack of talent, but because it was thought that possibly the work connected with these departments or divisions would be such that many capable, able men would not have time to accept the offices and carry on the work, but we have decided on the following Vice-Presidents:

Fish Culture, Mr. Charles G. Atkins, East Orland, Me.

Aquatic Biology and Physics, Dr. Barton W. Evermann, Washington, D. C.

Commercial Fishing, Mr. John W. Titcomb, Lyndonville, Vt.

Angling, Mr. John E. Gunckel, Toledo, Ohio.

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

For the Executive Committee: Dr. Charles H. Townsend, Chairman, New York City; Mr. George T. Mathewson, Thompsonville, Conn.; Mr. Jabe Alford, Madison, Wis.; Dr. Henry B. Ward, Urbana, Ill.; Mr. Daniel B. Fearing, Newport, R. I.; Mr. D. H. Power, Suttons Bay, Mich.; Mr. John P. Babcock, San Francisco, Cal.

The adoption of the report was moved and seconded.

Mr. Titcomb: May I ask what the duties of the Vice-Presidents are?

President: That was discussed at length yesterday before your arrival. It was proposed to have five divisions made of the subjects that naturally arise in the Society, and anything coming up under a special division would be referred to the Vice-President of that division.

Mr. Titcomb: I am a very busy man and do not know much about commercial fisheries. Considering all the talent that the committee has had to work over in deciding upon the proper men, I feel highly honored in the selection of my name, but I think it would be for the interests of the Society to have it withdrawn and someone else substituted in my place.

President: I suggest that we take action on this report as submitted. I think that Mr. Titcomb should withdraw his objection. This is a new feature, and certainly if anybody is qualified to handle his end of it Mr. Titcomb is, and I do not think he should object to serving.

The report of the nominating committee was thereupon unanimously adopted.

PRESIDENT: I suggest that the nomination of members of the Committee on Foreign Relations, which seems to have been omitted from the report, be re-referred to the Committee on Nominations. If that committee has no authority to make these nominations, the Chair would be pleased to entertain a motion giving it such authority.

MR. CLARK: It seems to me that the President of this Society is in better shape to get the right men on the Committee on Foreign Relations than is the Committee on Nominations. That has always been my view of it, and I supposed that was the way it had been done.

MR. MEEHAN: I move that the matter be referred to the Committee on Nominations for further action.

Motion seconded and carried.

The Committee on Nominations reported the following as members for the Committee on Foreign Relations:

Dr. Hugh M. Smith, Chairman, Washington, D. C.

Mr. E. N. Carter, St. Johnsbury, Vt.

Prof. E. E. Prince, Ottawa, Canada.

Dr. F. M. Johnson, Boston, Mass.

Mr. H. F. Du Puy, New York City.

Dr. James A. Henshall, Tupelo, Miss.

A motion was made, seconded, and unanimously carried adopting the report.

PRESIDENT: Is the Auditing Committee ready to report?

MR. MEEHAN: The Treasurer's report shows receipts to have been $940.05, while the expenditures were $717.26, leaving a balance of $222.79. The report was audited by the committee and signed by two of us, the third member not being present. I move that the report be received and adopted.

The motion was seconded and unanimously carried.

The report of the Committee on Foreign Relations was then presented.

MR. TITCOMB: I move that the report be accepted and printed, and that, if advisable, a few more pages be added before the printer receives the final copy.

Motion seconded and carried.

TIME AND PLACE OF NEXT MEETING

PRESIDENT: We will hear the report of the Committee on Time and Place of next meeting.

DR. EVERMANN: Your Committee on Place and Time of holding the forty-first annual meeting of the American Fisheries Society has the honor to report that it has considered the very cordial invitations from New Orleans, Denver, and St. Louis, these being the cities from which formal invitations have been received. After carefully considering the claims of these various cities the committee recommends that the forty-first annual meeting of the Society be held at St. Louis, beginning on Tuesday, October 3, 1911, provided that satisfactory hotel rates can be secured by the Executive Committee. This is respectfully submitted as the unanimous report of the committee.

I might say in explanation of the report that the invitations from these various cities were all very cordial and gave assurances that if the meeting were held in any one of them—either New Orleans, or St. Louis, or Denver—excellent treatment would be accorded by that city.

We all felt that the claims of Denver were strong, that there are many cogent reasons why the Society should meet at Denver. It has never met so far west, and there should be an opportunity of enlarging the membership, and the interests and effectiveness of the Society, by going to Denver. I think that the committee feels that an opportunity should be taken at no distant date to hold a meeting at that place. (Applause.)

Mr. Willard moved that the report be received and adopted and the motion was seconded.

MR. MEEHAN: This is not a criticism or anything of the kind, but did the committee in fixing October 5th as the date consider the other states? In Pennsylvania the trout are spawning and our trout men are busy, which will prevent nearly half of my men from attending the meeting. I do not know what effect it may have on some of the other states.

DR. EVERMANN: It is October 3d.

MR. MEEHAN: That is just as bad. At one of our stations this work commences the last of September, which is quite early; but by the 10th of October all our men are busy stripping. I do not know whether that follows in other states.

PRESIDENT: It is hard to fix any date that will not bar out some class.

MR. MEEHAN: I know it, but as that is the case with us may it not be so elsewhere? So far as the trout men are concerned I think there is more than one place where the trout are then spawning at hatcheries. It makes no difference to me, but it affects three men with us.

The report was then adopted.

REPORT OF COMMITTEE ON RESOLUTIONS

PRESIDENT: We will now receive the report of the Committee on Resolutions, of which Mr. Gunckel is Chairman.

MR. GUNCKEL: The Committee on Resolutions has the honor to make the following report:

Resolved, That the thanks of the American Fisheries Society be extended to the Board of Managers of the Zoological Society for the numerous courtesies extended to its members and friends through its director, Dr. C. H. Townsend.

Resolved, That the thanks of the American Fisheries Society be extended to the trustees of the American Museum of Natural History for the many courtesies extended on the occasion of the Fortieth Annual Meeting.

Resolved, That the thanks of the Society be extended to the Fishmongers' Association for the opportunity of inspecting under very favorable conditions the Fulton Fish Market at Pier 17, East River.

Resolved, That the thanks of the Society be extended to Dr. Hugh M. Smith for the interest manifested by him in the work of the Society, and especially for his remarkable success in securing additional membership.

Resolved, That the thanks of the Society be extended to Mr. Daniel B. Fearing, Newport, R. I., for the donation of a seal and engraved plate for certificate of membership, and for assistance offered in connection with the proposed index of the Transactions of the Society.

Resolved, That the American Fisheries Society, fully cognizant of the fact that fish propagation without fish protection and the maintenance of waters free from pollution cannot accomplish the full measure of success in the conservation of fish life and the development of fishery industries, strongly recommends that all proper means be adopted by the Society or by any of its members to secure more effective legislation, federal or state, for the protection of fish and for the adoption of some method of disposing of waste other than by pollution of the waters of our seas, lakes, bays, rivers, or smaller streams.

Resolved, That the American Fisheries Society wishes to express its gratification at the successful settlement of the Newfoundland fisheries dispute by The Hague Arbitration Tribunal.

Resolved, That the Society has learned with deep regret of the death of seven members during the year, and hereby extends its sympathy to the families of the deceased members mentioned below, and requests that notice of the action be duly transmitted to them by the Secretary:

Enrico H. Giglioli, Florence, Italy.
George F. Peabody, Appleton, Wis.
Charles P. Bennett, Providence, R. I.
J. Frank Ellis, Washington, D. C.
Charles H. Ferry, Chicago, Ill.
L. B. Spencer, New York City.
A. J. Kavanagh, Leadville, Colo.

Mr. Clark: I move the adoption of the report of the Committee on Resolutions.

The motion was seconded and unanimously carried.

Mr. Titcomb: I have a resolution here proposing to endorse and encourage commercial fish hatcheries, or in other words, the men who are engaged in raising trout, bass and other fish for market, so that they can find a market and not be restricted and subject to the same law applying to the sale of wild fish. Some states now have a law fixed so that a man can sell the trout he raises in his yard under certain regulations, at any time of the year. I will present this resolution later.

PRESIDENT: Unless otherwise ordered, the resolution will go to the Committee on Resolutions.

MR. MEEHAN: I do not want the Chairman of the Resolutions Committee to get away. I have been requested by Dr. Bean to ask the Chairman to present before the meeting such a resolution regarding commercial hatcheries. I believe at first the purpose was to assist in having New York pass something along this line; and while Dr. Bean would like to see such a resolution passed, he wishes to draw the attention of the Chairman of the Committee to the fact that there is already a law that covers the matter in New York.

PRESIDENT: There is another resolution by Dr. Henshall that I am informed by the Secretary should be presented.

MR. CLARK: In order to facilitate our business affairs, I suggest that these different resolutions coming in be handed to the Resolutions Committee for further action.

PRESIDENT: That will expedite the matter and it will accordingly be referred to the Resolutions Committee.

Returning to our scientific work, the first paper will be presented by Mr. W. E. Meehan, Commissioner of Fisheries, Harrisburg, Pa. The subject is "Work of Pennsylvania in Stopping Water Pollution."

The paper was then read.

PRESIDENT: We have an address to be delivered along largely similar lines, and I think we should have it before the general discussion is taken up. The presence at this meeting of a representative of our great sister nation on the north, a mighty empire that is developing by leaps and bounds, is, indeed, most gratifying if for no other reason than to emphasize the fact that this is not the United States Fisheries Society, but the American Fisheries Society. I take great pleasure in introducing to you a gentleman who has long been connected with fisheries and forestry conservation, Mr. Kelly Evans from the Province of Ontario. (Applause.)

Mr. Kelly Evans, Commissioner of Game and Fisheries of Ontario, then gave an address on "The Practical Enforcement of Fishery Regulations," which was discussed.

PRESIDENT: Dr. Morris has an announcement to make.

DR. ROBERT T. MORRIS, New York City: I wish to extend, on behalf of Dr. Lucas, Curator-in-Chief of the Brooklyn Museum, a special invitation to those in town this evening to view the educational exhibit of fishes and other animals, as you will find them on the second floor of the Brooklyn Museum of Arts and Sciences. Thursday evening the Museum is regularly open. It is the only natural history collection in the City of Greater New York which is regularly open on an evening of the week throughout the year. This is the evening for this week, and we shall be glad to see any and all of you there.

PRESIDENT: The Society will be glad to accept the invitation, for as many of its members as are able to attend, and we thank the Museum authorities very heartily. I understand that the Resolutions Committee has a further report to make.

MR. GUNCKEL: Since the first report of the committee we have received a number of letters and communications and suggestions. But the committee has decided that the majority of these have been taken care of at previous meetings and you will find them in the records of the past; even our old members like Dr. Henshall forget that some of these resolutions were passed years ago. As to the Panama Canal we thought we had better wait and see what kind of fish got into it when completed. The following additional resolutions are recommended by the committee:

Resolved, That the Society, fully appreciating the efforts now being made in behalf of conservation of natural resources, tenders its assistance and expresses its readiness to coöperate with the National Conservation Association in any way possible.

Resolved, That the Society recommends that all states encourage commercial fish culture by suitable legislation providing for the sale of game fish under regulation of the state fish commissions, provided such fish are properly tagged or that adequate provision is made against the sale of wild fish.

Mr. Clark: I move the adoption of the resolution on conservation.

Motion seconded and unanimously carried.

SALE OF HATCHERY FISH IN CLOSE SEASON

President: The second resolution is really intended to provide that growers of brook trout or other kinds of fish as a private enterprise may sell their products at any season of the year under proper regulations.

Dr. George W. Field, Boston, Mass.: If there is any objection to the resolution I will say that our experience in Massachusetts thoroughly convinces me that it should be passed for there is no more reason why we should forbid or prevent the cultivation and utilization of these fish as food by placing them on the market, than we should say that we must depend on the supply of wild strawberries for human food. I believe it opens a legitimate and proper source of food and an extension of the possibility of support for people who cannot afford to pay for extended trips; that the recreation uses are as advisable as setting aside public parks. It has been found by experience perfectly possible to recognize in the market and to prevent the sale of wild trout, and the matter of recognizing artificially reared trout, and in facilitating the marketing of them, is very readily handled.

Mr. Fenn: May I inquire of Dr. Field as to whether in Massachusetts the burden of proof is on the seller of the wild trout or on the commission, to prove that they are not wild trout. I ask this for the reason that we have a law in Connecticut forbidding the sale of wild trout, and authorizing under label the sale of hatchery-raised trout, and we distinguish them in that way. Now we meet with this difficulty there: a fish is found in a market, or cooked and placed on a restaurant platter, and the commission may bring an action; but we find it very difficult to prove our case unless we catch the man actually taking the wild trout from the brook; we find it very difficult to get a conviction;

in fact, we find it impossible in most cases to convict. I should like to know how they get around that in Massachusetts, unless there is a special provision in their act that the burden of proof shall be on the seller to declare where his trout were taken from. How do you differentiate so as to convince a country justice?

Dr. George W. Field: The law provides that the fish be sold under regulations made by the commission and approved by the governor and council. The burden of proof is on the possessor of the trout; he has to prove to the deputy by bill of sale, tag or otherwise, that it is not a wild fish.

Mr. Kelly Evans: It is a delightful thing to hear gentlemen conscientiously able to advocate such a resolution, because I take it to mean that the judicial machinery of their states is in wonderfully good order. I know in the province of Ontario it would be utterly impossible, as the law is administered, and as it will be for many years, to save our trout with such regulations placed on the statute book. I do not mean to say that I oppose the resolution in states with immense population and small area, where after all, the wild brook trout do not amount to much in the aggregate. But the only reason that we have saved the speckled trout in the Province of Ontario is that it has been illegal to sell them. We put a law on the statute book prohibiting the sale of muscallonge and bass, which has saved the muscallonge and bass of the province. Before that law was placed on the statute book they were catching bass with all kinds of contrivances in the northern part of the province and shipping them to your markets. You will find that thousands of pounds of muscallonge have been shipped out of the province. I notice in your magazines that there is a distinct leaning in certain directions toward the "more game" idea, as it is called. You cannot have a general rule for all conditions, and I take it that as each individual state increases in population it may be feasible to introduce such a scheme as is mentioned in this resolution, but where the ratio of size of the country to the population increases as it does to the north, I do not see any practical way of preventing the sale of the wild trout claimed to be domestic trout. It is hard enough as it is to prevent the wild trout being surreptitiously sold; but if you have this loophole of escape, why we might as well throw up our hands. And the point concerning our province is that the importance of the wild trout is so infinitely greater than the possible importance of the trout to the few people who would go in for raising them, that I think until the population is much greater, things had better remain as they are. If, however, you can produce such an excellent system in the different states of this country so that you can actually tag each domestic trout and follow it to its point of sale, it is, of course, the most magnificent system ever evolved; but I don't think in the wild state that it is feasible.

Mr. Richard E. Follett, Boston, Mass.: What might apply in the Province of Ontario might not apply in the State of Massachusetts. The domestic trout in the State of Massachusetts are of far more importance than the wild fish from the food standpoint.

Mr. Titcomb: I do not understand that Mr. Evans opposes this resolution. Is that correct?

Mr. Evans: Only that one point of the resolution should be more definite, and that is the point as to the practicability of the enforcement of the regulations under the resolution. I mean to say it is undesirable if it is simply a resolution passed and cited as an argument in favor of introducing the system in a state where we all know practically that existing regulations are not enforced.

Mr. Titcomb: Under this system I think we can protect our wild trout in any state in the Union better than we can without the system, that is in all states where we have commercial trout hatcheries. I presume it is the same with bass. Several arguments may be advanced. In the first place, if you can provide an abundance of fish in New York where people will have them in spite of all obstacles, if you can provide them trout from a commercial hatchery under proper restrictions, you will save the temptation offered poachers of bringing them in by improper methods and getting them to the tables of the people who want them. I believe that it can be regulated here in New York just as it is in Massachusetts, and I think Dr. Field will say that the law works well there; also I think Mr. Meehan will say that the law is satisfactory in Pennsylvania.

The commercial raising of fish will increase as the population increases in this country, just as it has in Europe. Almost all the fresh-water fishes there are raised in artificial ponds entirely under private control.

It devolves upon the various states to make their regulations under the direction of commissioners, which I think will obviate any danger of loopholes. I hope the resolution will be adopted at this meeting.

Mr. Evans: I have no objection to the resolution. I spoke more with a view of encouraging discussion on the question to find out if possible whether the commissioners of the states did not realize that in each state the condition must be faced as it existed there; that what would apply and be good policy in New York, would not apply and be good policy, for instance, in Ontario, and possibly in the State of Minnesota. I merely mention Minnesota at random as an example of some states where the area bears a greater ratio to the population than in Massachusetts or New York.

Mr. Fenn: I take it that this Society is more or less a protective association. Now why should we open the season so to speak by an official act of this association? Why so far as the seasons are concerned should the producer of trout, the grower of trout, to give him that term, enjoy greater privileges than the man who catches the trout? I think, as Mr. Evans has suggested, this is a matter for the legislatures of the several states and not a matter for this association, which is in its nature and character more or less of a protective association. I do not think a resolution of this kind is at all in the line of protection of our fish.

Mr. H. F. Hurlbut, East Freetown, Mass.: Perhaps I am an interested party, but I can bring you a little information from the men who sell the trout on the market here. They say it is a fact that after the first of January trout are brought into New York and are disposed of in various places, without danger to the man that puts them here, and these fish come, of course, from our private hatcheries. Now does this Society think we ought to be compelled to furnish trout here on the market against the law in response to the public demand? My product should have a free market as well as any other product. We take the eggs and we raise the fish. In Massachusetts a year ago last May a law was passed relative to the sale of trout and now we put trout on the market in Boston the year round with the exception of six weeks. This year we expect to put them on the market every week in the year, because the public wants them.

The Massachusetts law requires us to tag every trout that goes to the Boston market. We have a number and the officials have it, and if desirable they can trace the trout directly back to us. If we put in a trout that is not fit for market they have a chance to come back on us. This protects the purchaser, insuring that the trout shall be in proper condition for food.

I want to say, gentlemen, that since the enactment of the law in Massachusetts in opening the market of Boston, I have not sent over a thousand pounds of trout from our hatchery to New York. They have all been consumed in Boston, because we have had a market the year around, which is of great advantage to the people, as well as to us. We are able to keep our trout of the size that the market demands. It is a fact that the people of Boston do not want a trout that will weigh half a pound; they refuse them. We have to send those here to New York.

When I went out last year to California I stopped at Salt Lake four days and saw the trout in the markets there in tanks. I went to John Sharpe, former Commissioner, and asked him if he had any trouble about the wild trout being brought into the market. He said they had no trouble, and that trout are allowed in Utah to be put on the market the year around. The fish are not tagged but there are satisfactory provisions to take care of them.

I joined this association some years ago when it was not the power that it is today—this association is now a power in the United States—and a resolution from the Society will carry weight. I ask that the resolution be passed, for it will have weight with the fish and game commissioners of our states. I think the commercial trout men deserve to have the resolution passed.

President: We have a law of that nature in Michigan and it works very well. In fact it is in one way a measure of protection and for this reason: those who are in the business of raising trout cannot stand the competition of wild trout going on the market. A man who is raising trout cannot do so profitably unless he can get at least 50 cents a pound for them. Now, if wild trout are put on the market to any extent, the supply would soon exceed the demand and the trout grower would be put out of business. Any man that raises trout in private ponds is permitted to sell the year round under certain restrictions and so far as we know at the present time the privilege is not abused.

Mr. Meehan: We have a law in our state that has worked well, and it has encouraged hatcheries of the kind that have been directly beneficial to the state at large. I believe such establishments are of benefit, and I believe it is within the province of this Society to encourage them, if they are properly regulated. If anyone would like to have the law of Pennsylvania on this subject, I will be glad to send it to him. The hatcheries are under strict supervision, and there has been very little trouble in enforcing the law.

Dr. Townsend: I just want to submit a word of information on this point which came to me yesterday. I was talking to Mr. Hazard, of Carolina, R. I., President of the American Fish Culture Company, and he said that during the present year his fish hatcheries had put on the New York market over 30 tons of trout running about three to the pound. This is an important matter which is now under discussion.

Mr. E. W. Cobb, St. Paul, Minn.: There is one point that has not been touched on. Many commercial fish culturists have to get their fry into the ponds in February, and if they cannot market their fish in the winter they will be at a disadvantage. That will make a difference in the supply of commercial trout eggs. I do not know whether you can exactly call that a matter of protection, but it has given us our supply for the public streams, as the fish we have in the public hatcheries are principally from commercial trout eggs.

Mr. Hurlbut: I think Mr. Cobb makes a mistake in that altogether. If we can have a market the year around we make preparations accordingly. Last year we put trout into the Boston market except for six weeks. This year we have overcome that difficulty and preparations have been made to put them in every week, because the people want them. We do not sell our female trout when the eggs are worth as much as the trout. You need not think the commercial man that gets his living out of his business will spoil his business by throwing away the eggs. I do not think any of us would do that. But it is a fact with us as commercial men that we have three females to every male in our ponds. That will be a fair average. If a man is careful and has his ponds adapted to it, and makes his preparations as in any other business, he will get along all right. As a matter of fact I can tell in advance our output in a year as well as in any business you can find. We have it down to that; and as I say, we make preparations. Of course unforeseen accidents may happen; but barring them, we put trout into the Boston market every week through the year. At my little place alone this open market makes a difference of from $500 to $1,000 a year.

I am talking to you from experience. Mr. Titcomb knows my place; Mr. Bower and some of these gentlemen are acquainted with me and know what I have to work from; and if it is worth what I say to that small hatchery consider the advantages to everybody of an open market in New York, that will not require us to put trout in here against the law. The New York market is probably the largest market in the world for trout, but Boston is a good second.

MR. FULLERTON: We have a law in Minnesota allowing private hatcheries to market trout, but we have also a law, which has been upheld by the Supreme Court of our state, that the ownership of all game and fish is in the people, and that puts the burden on the man that has the trout. If we suspect a man he must show where the fish came from. I do not think Mr. Evans need be afraid in Ontario, if the burden is put on the other fellow. I believe this law is good and that the resolution should pass.

MR. LYDELL: I would like to ask some of the trout culturists what they would have to get per thousand for their eggs to make a living, provided they were not allowed to sell their trout; also if they were not allowed to sell their trout would the different state commissions or the United States Commission be able to get any trout eggs from them. Would it not be a fact that, if they were not allowed to sell trout, they would all discontinue operations, and thus put two-thirds of the fish commissions out of business as far as trout hatcheries are concerned?

MR. FOLLETT: That is a good point. My sympathies are with the private trout growers, and we all would like to offer them any assistance we can within reason.

The resolution was then unanimously carried.

PRESIDENT: The Secretary will now announce the next paper.

ACTING SECRETARY: Dr. Bashford Dean, of Columbia University, New York City, will read an announcement of Dr. Nishikawa's success in causing the pearl oyster to secrete perfect and spherical pearls.

The paper was read and discussed.

A recess was then taken until 1.15 o'clock p.m., at which time the meeting was called to order by the President.

PRESIDENT: The first paper this afternoon will be "Reminiscences of Forty-one Years' Work in Fish Culture," by James Nevin, Superintendent Wisconsin Fish Commission, Madison, Wis.

Mr. Nevin then read his paper, which was discussed.

PRESIDENT: Anyone who has had an experience of forty-one years in fish culture can certainly lay claim to be one of the earliest pioneers. There is, however, a gentleman present whose experience antedates that even of Mr. Nevin. He has the distinction of being one of the first ten men in the United States, of whom only three or four are still living, who hatched fish by what is known as artificial propagation. For a great many years he has been very active in the affairs of this Society, one of its standbys and mainstays, and for more than thirty years he has been one of the most commanding and conspicuous figures in fish culture in the United States. I have the honor of introducing him in the person of Mr. Frank N. Clark, of Northville, Mich. (Applause.)

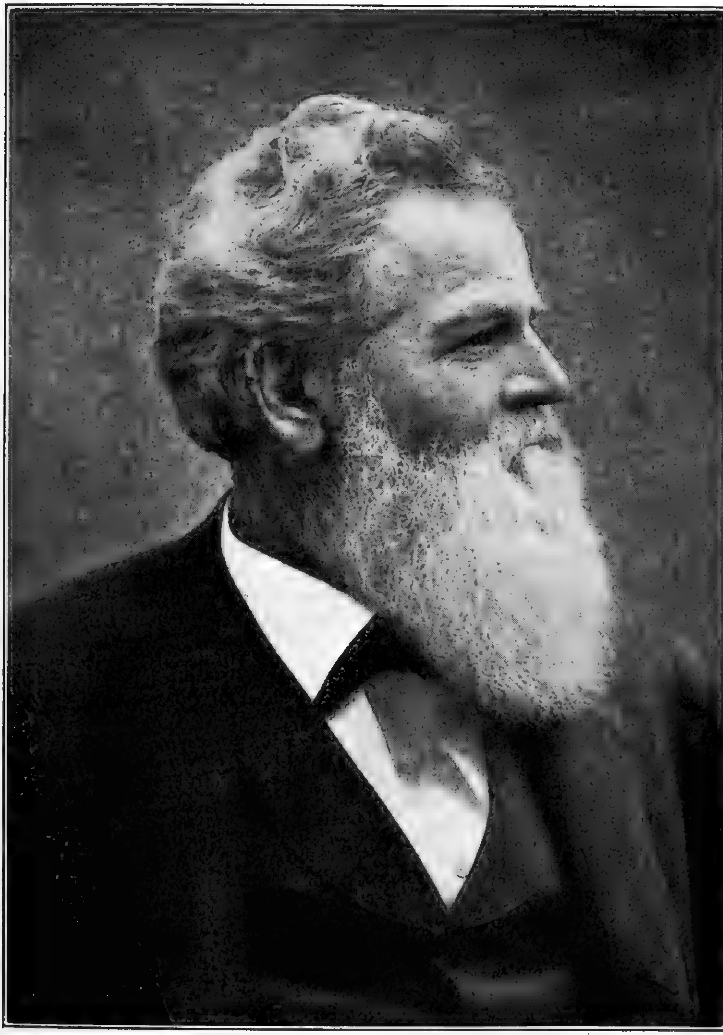
Mr. Clark then gave some extemporaneous "Personal Fish-Cultural Reminiscences," which will be found in proper order in the second part of the Transactions.

REMINISCENCES OF SETH GREEN

PRESIDENT: We have a number of communications here along this line from old-time members. Some of these letters are quite lengthy. I do not know whether you want them read or not. Here is one from Chester K. Green, son of the famous Seth Green. Will you have it read or read by title?

MR. MEEHAN: I think it would be well to read it, being from the son of one of the pioneers of fish culture.

The Acting Secretary then read the following letter:



Seth Green

Pioneer American Fish Culturist

Born March 19, 1817 Died August 20, 1888

CAPE VINCENT, N. Y., Sept. 20, 1910.

MR. SEYMOUR BOWER, President American Fisheries Society, Detroit, Mich.

DEAR MR. BOWER:—In response to your letter of recent date, relative to something in the reminiscent line of the early days of fish culture and the American Fisheries Society, I well recall the correspondence that took place between Hon. Robert B. Roosevelt, Mr. Livingston Stone, Mr. A. S. Collins and others with my father, Mr. Seth Green, relative to the organization of the Society and other important matters relating to it. I regret that I did not save some of the old letters, as they contained so many historical facts, and would have been of great interest on this occasion. Few of the younger members of this Society are familiar with the difficulties encountered by its founders, and the pioneers in the work of practical fish culture. Among the most serious problems to overcome, was the incredulity of the people and particularly the fishermen with whom it was necessary to come in contact in conducting the early experiments. Time will not permit relating many of these experiences, but a few will suffice. In looking over some of the articles written by my father in the early 70's relative to his shad-hatching experience, I take the following excerpt: "I underwent all sorts of annoyances by overgrown boys and grown-up loafers, who broke my experiment boxes and hooted at me. I was obliged to stay, for if I went home it was a failure, no matter what the cause. It is true I had not been used to being hooted at much in Rochester, but I soon got used to it, and not many days were passed in which my expectations were not realized."

When he had finally perfected his apparatus, and had his boxes filled with shad eggs in the process of incubation, he lay on the banks of the Connecticut River, revolver in hand, watching them. In the gray of the morning he discovered a man wading out to destroy them. He called to him to stop, at the same time leveling his weapon. It had the desired effect. The next day the boxes were filled with fry, and the victory was won. I can well remember talks I had personally with the fishermen on the Hudson River. They told me of the excitement that prevailed when he first made his appearance in the spring of 1868, at Mull's fishery on the upper Hudson, when he announced that he had come to propagate shad artificially, and make them plentiful and cheap. It was soon noised about that a strange man had made his appearance and was talking about doing marvelous and incomprehensible things in the way of hatching shad. They concluded he must be insane, but his earnestness and apparent confidence led them to call a meeting of their wise men, and hold a consultation with him. After the meeting the knowing ones reported that he might possibly be crazy or a fool; but he evidently knew what he was talking about, and knew more about fish than all the rest of them put together. So it was decided to give this man with unheard of ideas a chance to make a practical demonstration. The result is history.

My father and Mr. Roosevelt were very warm friends, both equally fond of fishing and field sports. Their practical experience and knowledge of matters pertaining to the disappearance of game and the decline of the fisheries, rendered them an ideal team in the inception and execution of the work of the New York Fishery Commission, of which they were both charter members in connection with Hon. Horatio Seymour.

Mr. Livingston Stone was so actively identified with the organization of this Society that I am sure a brief extract from his paper read before the National Fisheries Congress held at Tampa, Fla., in 1898, will be of interest, as it so beautifully expresses the conditions and feelings of the early experimenters:

"In looking back over those early years and contrasting them with the present, when such an immense mass of information is available, one is forcibly struck by the almost universal ignorance on the subject that prevailed at that time. This was true not only of people generally, but of well informed men also, for even scientists who rightly deserved the name, and university graduates and accomplished scholars who prided themselves on the variety of their knowledge, and reading men who kept up with the magazines and newspapers, could tell you nothing of this art of fish culture. Yet this was not so very surprising, for books had not then been published in this country on the subject, magazine articles about it had not appeared, encyclopedias did not contain the information, or at most only the merest outlines of it, and there was no avenue open to the public by which more than a superficial knowledge of the subject could be reached. People generally were so utterly ignorant indeed of the whole subject that almost any story about fish eggs would pass unchallenged. How different the present day, when the minute fish life of the very bottom of the ocean is closely and thoroughly studied, and the fish food furnished by the microscopic life of fresh-water lakes is measured and classified.

"To go back in memory to those early days is not only to lend the enchantment that distance brings, but it is also to return to what was real enchantment then. It seems as if we should never feel again—I know I am expressing the feelings of all the early experimenters in hatching fish—it seems as if we should never feel again, and we shall probably never feel again the thrill of excitement that tingled to our fingers' ends when we first saw the little black speck in the unhatched embryo, which told us that the egg was alive. It was one of the dearest sights on earth to us then. And when the first little trout emerged from its shell and wriggled in the water, why were we so excited and elated? Was it because the little fish opened up to us a new world of promise, and because we had a dim vision of the countless multitudes of living creatures that this little embryo was the significant forerunner of? Was it because we unconsciously felt we were sharing with others in a great discovery? I suppose it was something of the sort, and now after those long years have passed and we coldly watch under a microscope, with half scientific interest, the development of this little black speck, named by scientists the 'choroid pigment,' but which will always be dear to us as the 'eye-spot,' we can hardly believe that such a commonplace matter-of-fact affair could ever have stirred our feelings and our imagination as it did once, when the sight and sensation were both new, and the world of promise before us was untried and unknown."

While there are many other interesting incidents that come to my mind in connection with the early work, I feel that I must not further encroach upon your valuable time.

In closing permit me to extend my congratulations to the American Fisheries Society upon attaining its fortieth anniversary. The great good this Society has done in the past and is still doing, is incalculable, and that it may continue to expand and increase in usefulness and activity for many years to come, is the sincere wish of

Very truly yours,
Chester K. Green.

LETTERS FROM ABSENT MEMBERS

President: I think this is a very valuable contribution from one of the old members. It is true that in America the first fish were hatched by Dr. Garlick, of Cleveland, but it was only in a very small and experimental way. The fact is that Seth Green is the real pioneer of fish culture in this country, so far as hatching fish in a practical way or as a business enterprise is concerned. I think there is no question about that. Here is an interesting letter from James Annin which I will ask the Secretary to read.

The Acting Secretary then read the following letter:

Caledonia, N. Y., Sept. 24, 1910.

Mr. President and Members of the American Fisheries Society, Greetings:

The President asked for a letter from members that had belonged to the Society for twenty-five years or more, and stated that with myself there were but fifteen left.

I am getting white and the hair is a little thin, but I do not feel a day older than when I joined the American Fish Cultural Association in 1877 or 1878. The only thing that convinces me of my age is the way my wife looks after me on my return from a day spent on the stream or in the brush.

I joined the association during R. B. Roosevelt's administration. Since then the name has been changed to the present one. I shall always consider it a privilege to pay my yearly dues to this Society.

For several years the annual meeting was held at New York in the Fishmongers' Association assembly room over the market. Many interesting matters came up for discussion, many pertaining to the future of fish culture and the widespread influence for its success the association must have throughout the country and world. I wish that many of the old members were alive and present to see and hear how their hopes for the future of fish culture had been confirmed. Robert B. Roosevelt, George Shepard Page, Seth Green, Eugene G. Blackford, Fred Mather, Spencer F. Baird, G. Brown Goode, James Benkard, W. M. Hudson, Marshall McDonald, and a host of other eminent men were always present and took an active part in the discussions.

Many of the early annual meetings were held the last days of March just before the trout season opened, when Mr. Blackford invited the members of the association and the public to inspect his display of live and dead trout from every available part of the country. No expense was spared to make it a success. It was always a splendid display, and anticipated by all with pleasure.

On the occasion of one meeting, a dead whale had been towed in and anchored near the Fishmongers' Market by some thrifty financier who enclosed it with a fence with steps in place from the pier, permitting those that paid the admission fee to walk on the whale's back. Several members paid the price, but most of us thought after getting inside the fence and seeing the condition of the big monster that it was safer to look at and smell from above.

I am sorry that I cannot have the pleasure of being with you at this, the fortieth annual meeting.

Trusting that you have a pleasant and profitable gathering, I remain,

Sincerely yours,

JAMES ANNIN.

PRESIDENT: I have a letter from Dr. Smith, who is unavoidably absent from this meeting, which I am sure we all regret. Dr. Smith took a very active interest in trying to work up material for this meeting until he was unexpectedly called to the conference at The Hague. The letter reads:

North Atlantic Coast Fisheries Arbitration at The Hague.
Agency of the United States

Sept. 12, 1910.

MR. SEYMOUR BOWER, President American Fisheries Society,
New York City.

MY DEAR SIR:—It is a matter of great regret that I am unable to be at the anniversary meeting of the Society, to which I had been looking with pleasant anticipation.

I have prepared a little historical account of the great international fishery dispute between America and England that has just been settled by arbitration, and I hope you will find a place for this article in the printed record even if it is not read at the meeting. The case is noteworthy in being the first to come up under the convention for the settlement of international disputes concluded at the second peace conference at The Hague in 1907.

Will you please convey to the members of the Society my greetings and best wishes for a most successful meeting. Sincerely yours,

HUGH M. SMITH.

PRESIDENT: Here is a short letter from an old-time honorary member that should be read.

The Acting Secretary then read the following letter:

HAARLEM, HOLLAND, Sept. 16, 1910.

Mr. Seymour Bower, President of the American Fisheries Society.

SIR:—I have duly received the announcement of the fortieth anniversary meeting of the American Fisheries Society and I am sorry not to be able to attend it.

Yet it would have given me great pleasure to do so and to use the opportunity, personally, to express my feelings of sympathy with your Society. So I am now obliged to do this by letter: receive my hearty congratulations and my best wishes for the future on the occasion of the fortieth birthday of your Society.

Having had the great honor, some years ago, to be elected an honorary member, having studied the proceedings on several occasions, and having had the advantage of making personal acquaintance with your Society, being present at the Washington meeting in September, 1908, I am, no doubt, permitted to say that your Society has already done excellent work in the interest of your fisheries, and that we are fully entitled to expect that it will, in future also, largely contribute to the maintenance and the development of this industry which so greatly interests us.

With my best wishes for the success of your anniversary meeting and my respectful greetings for yourself and for many of your members, whom it would be for me a great pleasure to meet again, I have the honor to be, Sir, yours sincerely and respectfully,

P. P. C. HOEK,
Honorary Member.

PRESIDENT: We have a short letter from Professor Prince, Commissioner of Fisheries of the Dominion of Canada, that I should like to have read.

The Acting Secretary then read the following letter:

WYNYARD, SASK., Sept. 16, 1910.

The Secretary of the American Fisheries Society, New York Aquarium, New York City.

DEAR SIR:—I very much regret to find that I shall be away on an official trip over the northern waters of Alberta, Canada, at the time of the meeting of the American Fisheries Society. I had hoped to be present, along with my distinguished colleague on the International Fisheries Commission (Dr. David Starr Jordan) and to have contributed one or two papers. I shall be wholly unable to attend the meeting or aid in any way personally, but I wish it all success.

Yours faithfully,
EDWARD E. PRINCE.

PRESIDENT: There are three other members who have belonged to this Society for more than twenty-five years who have been in attendance at this meeting, but they are not present now, Dr. Bean, Dr. Gill, and Mr. May.

MR. MEEHAN: Dr. Bean is absent on account of the severe illness of his wife.

PRESIDENT: I am advised that there is a member present, and yesterday reëlected to membership, who first joined the Society in 1873. We shall be glad to hear a few words from Mr. Philip Neidlinger, of Sheepshead Bay, N. Y.

MR. NEIDLINGER: I have nothing to say just now except that many years ago at our meetings, when Mr. Roosevelt was president, and George Shepard Page and Seth Green, and others dead and gone, met with us, I attended the sessions and enjoyed them very much. But I lost track of the Society until I read about the meeting here, when I at once took occasion to attend and renew my membership.

EARLY WORK OF CHARLES G. ATKINS

MR. W. O. BUCK, Neosho, Mo.: I would like to ask if there is anything from Mr. Atkins?

PRESIDENT: I wrote to Mr. Atkins but he did not respond. There are some pictures here of a few old-time members, among them being one of Mr. Atkins, which I shall be glad to show you later.

MR. BUCK: It seems to me that the Society owes it to itself to have Mr. Atkins' name appear in this account of its early members, and if you will bear with me a minute I will try to state something of what I happen to know of the earlier part of his fish-cultural work. My having been associated with him for twenty years perhaps may furnish an excuse for my speaking in his behalf without other preparation than those twenty years of familiar intercourse and knowledge of his work.

Mr. Atkins was one of the two first commissioners of the State of Maine appointed in 1867, and he brought from Canada, in 1870, the first salmon eggs artificially hatched in Maine. There were 8,000 of these for which he paid forty dollars in gold per thousand, and he brought them home in a trunk. Although the result of this experiment was limited as to the total number of fish produced, they were of excellent quality, over 7,000 young fish being carried to the planting time the following winter. Later he made the first attempt to take salmon eggs in the United States, buying live adults of the fishermen in June and July, and impounding them in several places. The inclosure in Alamoosook Lake at the mouth of Craig Brook proved to be well adapted to the purpose, and the salmon there confined yielded 70,000 eggs, of which Mr. Atkins succeeded in fecundating 96 per cent, using the dry method of applying the milt—the first time that method was ever used in America. Craig Brook is the place where Mr. Atkins has since had such great success in salmon culture, although he at first moved from there to a brook in Bucksport where he carried on operations for several years.

During that time he organized an association of commissions of the States of Maine, Massachussetts, New Hampshire, and Connecticut, for the purpose of propagating Atlantic and land-locked salmon. When the United States Fish Commission was established Professor Baird joined this association, each of the commissions contributing to the fund for carrying on the work and sharing in the output. As Maine commissioner, Mr. Atkins was the author of the first five reports—1867-1871—which cover a wide field. He entered the service of the United States Commission in 1872, and as we all know contributed many important articles to its early reports.

Prior to 1875 he had hatched eggs of Atlantic salmon, land-locked salmon, shad, whitefish, brook trout, lake trout, alewives, white perch, smelts, suckers and chubs.

Perhaps this is enough to say at present, the idea being to refer briefly to some of the little known beginnings of Mr. Atkins' work rather than attempt a summary of that for which he is so well and widely known.

PROCEEDINGS RELATIVE TO LIVINGSTON STONE

PRESIDENT: I have reserved for the last a letter from Mr. Chester K. Green concerning the only living charter member of the Society, Mr. Livingston Stone, whose condition seems good physically, but whose mental condition is very poor. He recognizes those around him, but his memory is gone and the past is a blank. I think some suitable action should be taken in connection with our oldest living charter member. The Secretary will please read the letter.

Mr. Green's letter follows:

CAPE VINCENT, N. Y., Sept. 19, 1910.

MR. SEYMOUR BOWER,

President American Fisheries Society, Detroit, Mich.

MY DEAR MR. BOWER:

I am in receipt of your letter asking for information concerning Mr. Livingston Stone. Mr. Stone's son visited Cape Vincent a short time since, and from him I learned that his father's condition is such that he is able to be about each day, and is in fairly good physical condition. His mental condition is somewhat peculiar, and, as I understand it, he lives almost entirely in the present—that is, he knows those about him, converses and plays games with them, but does not remember anything in the past. He may recognize an old friend who calls on him, but will forget all about him a short time after leaving. He does not remember anything about his fish-culture work at Cape Vincent or elsewhere, or his associates in the work. His case is in many respects a very pitiful one, but it will be a consolation to his friends to know that he is not suffering any physical pain, and that he has a nurse in constant attendance, and is being well cared for by his faithful wife and son. His address is 835 E. Hutchinson Avenue, Swissvale, Pittsburg, Pa.

I trust that I have given you the desired information.

Sincerely yours,

CHESTER K. GREEN.

Mr. Clark: I move that the Secretary at his convenience a little later write a letter to Mr. Stone, or his wife or his son, or all of them, expressing the sympathy of the American Fisheries Society as to his condition, saying that the members of the Society thought of him while holding this fortieth anniversary meeting.

Mr. Titcomb: May I add to that message and have the motion that we make Mr. Livingston Stone an honorary member of this Society?

Mr. Clark: I accept that amendment as part of the original motion.

The motion was unanimously carried.

Acting Secretary: The Society took action of similar nature three years ago when resolutions of sympathy were extended to the family regarding Mr. Stone's condition, very much after the manner of the present occasion.

President: I believe this closes the hour we were to devote to reminiscences, but I will say that you will perhaps want to see the pictures of five of the early members of the Society, Mr. Atkins, Mr. Seth Green, Mr. Fred Mather, Mr. Livingston Stone, and Mr. Robert B. Roosevelt.

Acting Secretary: These photographs were brought here at the request of Dr. H. M. Smith and are his property.

President: Mr. August Christman, Secretary of the United Anglers' League of New York, has a few remarks to make.

Mr. Christman: The most detrimental thing to the sport of angling about Greater New York is the pollution of the waters. We have a law that prohibits pollution; but we find that New York City itself is the greatest offender against the law. We find another thing, that the menhaden fishermen on the coast come as close as a quarter or half a mile to shore after menhaden, but if they should chance to run into weakfish or the like they do not hesitate to take a seine and catch them. They may not bring them into market; I cannot say that because I do not know it to be a fact, but I know that the individual angler can go alongside of those boats and procure the fish at a small sum.

PRESIDENT: The Secretary will announce the next paper.

ACTING SECRETARY: Prof. Francis H. Herrick, Adelbert College, Cleveland, Ohio, sends a paper on "Protecting the Lobster," with the suggestion that it be read in full or by title only, according to the exigencies of the occasion.

DR. OSBURN: Professor Herrick's paper is of such an excellent character that the committee thought it best to read the paper even though he is absent.

Dr. Osburn then read Professor Herrick's paper, which was discussed.

The Acting Secretary then read a paper written by Mr. E. W. Barnes, of the Rhode Island Fisheries Commission, entitled "The Season of 1910 at the Fisheries Experiment Station at Wickford, R. I., which was discussed.

PRESIDENT: The next paper will be read by a gentleman to whom we are under great obligations for his assistance in making this meeting a success. Dr. Raymond C. Osburn, of Columbia University, and Assistant Director of this Aquarium, will speak on "The Effects of Exposure on the Gill Filaments of Fishes."

DR. Osburn's paper was then read and discussed.

PRESIDENT: The Secretary has started to prepare a history of the Society. He has merely the rough draft today, and will read only a small portion of it, as a great deal of it is necessarily statistical, but really should be put in the report when it is fully completed, because it will save some one else a lot of time in compiling the same set of facts.

The Acting Secretary, Mr. Ward T. Bower, United States Bureau of Fisheries, Washington, D. C., then read a "History of the American Fisheries Society."

Mr. Roy W. Miner, Assistant Curator of Invertebrate Zoology, American Museum of Natural History, then spoke on "The Study of Marine Ecology and its Importance to the Fisheries." Discussion followed.

President: Fish have diseases and consequently we must have fish doctors to diagnose and prescribe for those diseases. Our next paper will be by one of the fish doctors of the Bureau of Fisheries, Mr. M. C. Marsh, who will present a paper on "Thyroid Tumors in Salmonoids."

Mr. Marsh's paper was then read and discussed.

PAPERS READ BY TITLE

President: We have about 15 more papers and if you think it is too late to read them, the Chair will entertain a motion that they be read by title and printed in the proceedings.

Mr. Meehan: I move that the papers remaining be read by title and published in the proceedings.

The motion was seconded and unanimously carried.

Papers were then read by title as follows:

John P. Babcock, Chief Deputy California Fish and Game Commission, San Francisco, Cal.—"Some Experiments in the Burial of Salmon Eggs, Suggesting a New Method of Hatching Salmon and Trout."

Dr. S. P. Bartlett, U. S. Fisheries Station, Quincy, Ill.—"Rescue Work—The Saving of Fishes from Overflowed Lands."

D. C. Booth, Superintendent U. S. Fisheries Station, Spearfish, S. D.—"Fish-Cultural Possibilities of the National Preserves."

W. O. Buck, U. S. Fisheries Station, Neosho, Mo.—"Pike-Perch Notes."

Prof. T. L. Hankinson, Charleston, Ill.—"Ecological Notes on the Fishes of Walnut Lake."

John L. Leary, Superintendent U. S. Fisheries, San Marcos, Texas.—"The Sunfish."

H. Wheeler Perce, President National Association of

Scientific Angling Clubs.—"Some General Remarks on Fishing for Sport."

Dr. Hugh M. Smith, U. S. Deputy Commissioner of Fisheries, Washington, D. C.—"The North Atlantic Fisheries Dispute and its Arbitration at The Hague."

E. A. Tulian, New Orleans, La.—"Five Years' Progress in Fish Culture in Argentina."

S. G. Worth, Superintendent U. S. Fisheries Station, Mammoth Spring, Ark.—"Observations on the Natural Food of Small-mouth Bass Fry at Mammoth Spring Station, Arkansas."

President: I am requested by an old member to bring the following to your attention: He desires to have published in the proceedings of this meeting the names of commissioners and superintendents of all the states, the amount of money appropriated by Congress for the Bureau of Fisheries and by the different states, the number of fish planted under the direction of the Bureau and the different states, these data to be incorporated in our next report. What action will you take on this request? It would be a good idea in some respects, although we are going to have an enormously large report, as it is. You know the discussions that have been had and the papers that have already been presented, and there are about 15 papers that have been read by title and are to be printed; but as this request is made by an ex-president and an old member, it is entitled to consideration.

Dr. Townsend: It would involve a vast amount of work for an unpaid secretary.

Mr. Clark: I move the matter be laid on the table until our next annual meeting.

The motion was seconded and carried.

CLOSING PROCEEDINGS

President: When you elected me as President a year ago, I felt a sense of honor and appreciation which I could not adequately express in words. I am a good deal in the same embarrassing situation at the present moment with respect to the cordial and united support that has been accorded me during the year. I want to thank each member individually, and I want to thank you all collectively for what you have done to make my administration a success, and which has culminated, through your efforts and not my own, in making this one of the best meetings in the history of the Society.

My only hope is that you will accord my successor, each and everyone of you, the same support that you have me, and that the next meeting will be a much better one than this, and much better attended.

As the time is too short for any extended remarks, or any formalities, I will appoint Mr. Titcomb as a committee of one to escort the new President to the chair, and his term of office will begin upon his introduction.

The President-elect, Mr. W. E. Meehan, was escorted to the chair by Mr. Titcomb.

Mr. Titcomb: Gentlemen of the American Fisheries Society, I have just been called upon to introduce the incoming President, and, as the retiring President has said, this is no time for extended remarks. Mr. Meehan is known to all of us; he has been a very earnest, hard-working member and has brought with him to these meetings, for a great number of years, 12 or 13 of the fish culturists at his hatcheries, all of whom seem to think they are getting much interesting and useful information here. I hope all the other commissioners will profit by this example hereafter. I have great pleasure in introducing your new President, Mr. Meehan. (Applause.)

Mr. Meehan took the chair.

President W. E. Meehan: Ladies and gentlemen of the American Fisheries Society: It has been considered by me an honor and a privilege to be a member of the American Fisheries Society. I have been a member for nearly twenty years and have taken a very active part for nearly half that period, sometimes perhaps to the dissatisfaction of some of my friends. Thus esteeming the honor of membership, I appreciate the more deeply the honor of the office which you have conferred upon me.

I feel that I have a big task before me on account of the splendid work of the preceding President. I shall do my best, however, to maintain his record. If my administration is successful, or if it should turn out that there is a better and larger meeting next year than this, it will not be due to me, but to you, who should endeavor to achieve, if possible, greater success even than has my predecessor, Mr. Bower. (Applause.)

The Society has reached a point where it must be from this time forward a big factor in a wider field than it has hitherto occupied. I have watched it grow from the time when only a few members were here, to the time when we had a large membership, from the time when discussions were limited principally to trout and carp, to the broad field of taking in nearly all the valuable food fishes that we have in the country.

We are going now to another and stronger position which we have been urged in this meeting to take, namely the purification of the waters, in order that the labors of fish culturists may bear greater fruit. Why should we attempt to propagate fish, if the waters are in such condition that plankton will not successfully grow? It will be part of the province of this Society to work for the purification of our waters. Some of the states need legislation toward that end and I believe that we can do much in securing such legislation.

Gentlemen, I shall do the best I can in the coming year, and I again thank you for the honor which you have bestowed upon me. (Applause.)

I think we usually have a few words from other officers-elect, and I will appoint Dr. Townsend as a committee of one to escort the new Vice-President to the chair, to hear a few words from him.

Dr. Townsend escorted Mr. Fullerton to the platform.

Mr. Fullerton: I want to thank you for electing me Vice-President. I deem it a great honor. In connection with my present visit to New York I would like to state that 37 years ago tomorrow I landed at Castle Garden on the site of the Aquarium.

President: I will appoint Mr. Seymour Bower to escort the Secretary to the rostrum and introduce him, that we may have a few words from him. (Applause.)

Mr. Ward T. Bower, the Secretary-elect, was then escorted to the platform.

Mr. Ward T. Bower: Mr. President, ladies and gentlemen, I remember several years ago at a meeting of the Society when General Bryant was called upon suddenly for some remarks he said: "In the language of the young ladies when proposed to, 'This is so sudden.'" While ordinarily no little honor attaches to the office of Secretary, I believe you will agree with me that it not infrequently happens that the duties are rather arduous and irksome. However, upon the present occasion I am happy to state that this condition does not at all alarm me, for the reason that you have very thoughtfully elected an Assistant Secretary in the person of a lady—the first lady to hold office in the American Fisheries Society. (Applause.) I am certain that Miss Smith will be an honor and a credit to the Society in that office. Permit me to express my thanks for the honor you have conferred upon me.

Dr. Townsend: I think I should take occasion to state on behalf of the Zoological Society that it has given us great pleasure to have you meet under our roof at the Aquarium, and also to say that the Aquarium is always at the disposal of the American Fisheries Society. I am going to be vain enough to show you the picture of the new Aquarium that will be begun soon. If you come here in two or three years we will give you an elegant meeting place in the new building. (Applause.)

Mr. Seymour Bower: I want to call attention to the fact that the publication of the proceedings of this meeting is entirely in the hands of the Special Anniversary Committee. It was arranged at last year's meeting and the action still stands, so that all papers relating to the forthcoming report should be placed in the hands of the chairman, Dr. Townsend.

PRESIDENT: Is there any other business? If not, we are ready for adjournment.

MR. SEYMOUR BOWER: I move that we adjourn sine die.

Motion seconded and carried.

PRESIDENT: This meeting is adjourned sine die.

In Memoriam

CHARLES P. BENNETT

FRANK NELSON CLARK

J. FRANK ELLIS

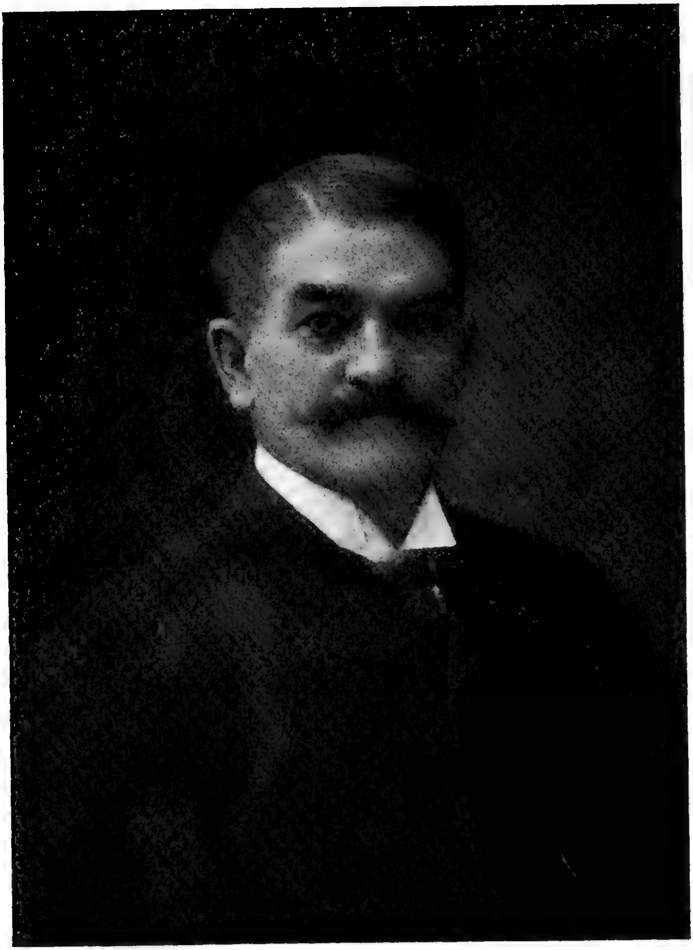
CHARLES H. FERRY

ENRICO H. GIGLIOLI

A. J. KAVANAGH

GEORGE FREDERICK PEABODY

L. B. SPENCER



Frank N. Clark

President of the Society 1903-1904

Born February 2, 1849 Died December 19, 1910

MEMORIAL OF FRANK NELSON CLARK

ON THE nineteenth day of December, 1910, there passed from this life one of the most prominent and useful members of this Society. Attending to his usual activities until the very day he was called, the end came with a suddenness that startles and shocks. With no note of warning there was struck from our rolls the name of one who for many years labored earnestly and conscientiously to build up this Society, one who was ever solicitous for its welfare, one who in every way was a credit and honor to its membership. As a lifelong and intimate friend and associate it is to me a sacred privilege to be permitted to pay tribute to his memory.

Frank Nelson Clark was born in Clarkston, Mich., a village that perpetuates the name of his immediate ancestry and relatives, who were its earliest pioneers and its founders. Surrounded by lakes and nestling in the very heart of a noted lake region, it was most fitting that this beautiful village should be the birthplace of fish culture in Michigan. Moreover the pioneer fish-cultural enterprise was among the earliest of its kind on the American continent.

The first man to propagate fish on a practical basis in this country was Seth Green, of New York. This was in the early sixties. He was soon followed by Samuel Wilmot, of Ontario, and Nelson W. Clark, of Michigan, father of Frank N., who was identified with his father's fish-cultural efforts almost from their earliest inception in the winter of 1866-67. Necessarily this pioneer work was carried on as a private business, for fish culture as a public enterprise was also in its infancy. A board of fish commissioners had been established in three or four of the eastern states, but there were no state or public hatcheries; and the federal government did not take up this work until 1871.

The Clarks, father and son, met with discouragement at first, but their work soon developed into a distinct fish-cultural success. They were, however, confronted with the more difficult problem of making a pecuniary success of a business that was years in advance of the time. Nevertheless they struggled on and on with unflagging interest and unfaltering faith in the future of fish culture. Father and son alike were born fighters, with splendid physical equipment and mental resourcefulness. Both were throbbing and pulsating dynamos of human energy, and so they swept opposition aside and beat down and conquered adversity.

In 1874 they moved to Northville, Mich., where, at that time, better facilities for propagating brook trout were available. Two years later the father died, but the son continued the business as a private enterprise until 1880. From the modest and inexpensive plant of that day has grown the splendid establishment now at Northville, due almost wholly to the genius, persistence, grit and unconquerable energy of Frank N. Clark.

From 1874 on into the early eighties he was employed by the United States Fish Commission at certain seasons of the year in hatching shad and other marine species of the Atlantic coast, and the distribution of these fish took him to many parts of the country and as far west as the Pacific coast. There were no fine hatcheries in those pioneer days, no distributing cars with an ample crew and special equipment and comfortable eating and sleeping quarters. Trips to the Pacific States with live fish meant almost continuous hard work in a baggage car for eight or ten days. Field and hatching stations more often than otherwise were in tents or temporary shacks or fishermen's shanties. There were no easy places in those times, but rather only those privations and days of arduous toil that seem always to be associated with pioneer efforts. And thus it was that Frank N. Clark acquired much of his early education in fish culture in the hard school of practical experience.

And yet, with all of its seeming drawbacks and hardships, the work for him had a peculiar fascination, for the greater the difficulties encountered the more he persevered and the heavier he drew on that tremendous reserve force of energy which was his in the fullness of his early manhood.

It was undoubtedly the reputation earned by the Clarks, father and son, as pioneer fish culturists, that led to the son being called into the service of the federal fish commission in 1874. Here his successful work, his zeal and energy, and his enthusiasm and optimism and abiding faith in the future of fish culture, soon attracted the attention of Prof. Spencer F. Baird, the first United States Commissioner of Fisheries. As time went on that truly great and good man and Mr. Clark were drawn into much closer relations. Thus his true worth as a practical fish culturist was recognized by one of the greatest scientists of the time; and when, in 1880, funds were available for propagation service on the great lakes on a scale of some magnitude, he was appointed its first superintendent. He was not only the logical man for the place, but unquestionably the best equipped, both in experience and mental and physical endowment. With boundless energy and ambition he at once inaugurated and prosecuted a campaign that was fought with vigor and signal skill and ability until the very day of his untimely taking off. As he grew and developed and expanded, so did the work which he loved so well, a work that is conceded to be one of the conspicious fish-cultural successes of his time. As he broadened and deepened and ripened, he became, in my judgment, easily the ablest and most successful superintendent in the employ of the Bureau of Fisheries and unquestionably the most forceful.

As a prophet is not without honor save in his own country, so it is, I believe, that Frank N. Clark's standing in the sphere of his special activities was not known or fully appreciated in his own community, for he was a national figure in fish-cultural circles and his reputation was nation-wide in this field of endeavor.

What are some of the reasons for the splendid achievements that were his in the chosen field of his life work? First, we find that his heart was in his work and that there was a fighting determination to succeed, two prime essentials for success in any field of human activity. These were backed up and fortified by an inexhaustible fund of energy. Then, we find a genius for organization, the faculty of properly assigning his subordinates and, like a skilful general, so deploying his forces as to secure the highest degree of efficiency from the material at his command; and finally, with his own enthusiasm and fearlessness to so inspire confidence in his leadership as to spur his men on to their best efforts. We might sum this up by saying that he was a born leader, a born commander, one of that type of strong and forceful men who forge to the front always in every field of effort that attracts and challenges and draws out their best energies.

During the last twenty years or more he was prominently identified with this Society, the leading and most influential organization of its kind in existence. Here again that natural leadership which was an inseparable constituent of his being, soon asserted itself. He was one of its standbys and mainstays and stalwarts, one of the loyal old guard whose advice and counsel practically determined its policies and shaped its destinies. He served as its president for the constitutional limit of one term.

He contributed a number of papers and always participated freely in the discussions. He was ever eager to learn and to draw out the newest and latest and best in his line of work, but he was equally generous in imparting information from his own storehouse of knowledge. Much might be said of his connection with this Society and of his fidelity and faithful devotion to its best interests, but we will pass on by saying that his papers and discussions were ever marked by that same candor and fearlessness in the expression of honest opinion that characterized his utterances everywhere.

Since the passing of our late associate I have received a number of letters of regret and sympathy, but reference will be made only to one, one which in a few words bears witness to his standing in fish culture, from the author of many scientific treatises and popular works on water life—Dr. David Starr Jordan, one of the most eminent ichthyologists and zoologists of his time:

I was very greatly pained lately to learn of the untimely death of Frank Clark. I pray you to convey to his good wife my sympathy in her affliction. Mr. Clark was one of the ablest men in the field of fish culture. I do not myself know that he had any superior, and it is a great pity that he should be lost so early in the great work he was doing.

Almost from the day he was laid away forever I have been asked, "Who is going to fill Frank Clark's place?" and I have said, in my personal and business life his place is not going to be filled because there is no one on this earth who can fill it. If you mean to inquire who is going to fill his place in fish culture, I want to say as emphatically as possible that it is not going to be filled by any one man because I believe that there is no one man who can fill it. This is said with all due respect to the many capable men in the employ of the federal and state fish commissions, all of whom are known to me either personally or by reputation. This does not mean that there are no others who can hatch fish as well as he; there are, and possibly even better.

But Frank Clark was far more than a mere fish culturist in the sense that to be known as a fish culturist one needs only to be familiar with the comparatively simple processes of hatching fish; he was far more than a mere station superintendent carrying out an official routine laid down by official superiors. He was cast in much larger mould. He comprehended the broader and deeper and more far-reaching phases of fish culture and fishery conservation. He in short grasped and fully appreciated the fact that the great problems of fish culture and their relations to one of our most important food resources, are ocean deep and earthwide in their significance and application, and that within a few generations the solution of these great problems will be of tremendous import to the human race.

And thus it was that he grew to be one of the most conspicuous and commanding figures in fish cultural circles in this country. More than that, he was a vital, virile, living, dominating force in fish culture, the influence of whose work and teachings and ideas and personality reached into the field of fish-cultural endeavor everywhere, not only in this country but abroad. And these are the more significant, the more potent, the more convincing, the more compelling reasons why Frank Clark's place in the world of fish culture is not going to be filled.

And now I am moved to say a word of a more tender and personal nature, for I believe that my relations with our late beloved friend brought me closer to the bottom of his heart than did those of any other living man.

It was my good fortune to be born and to grow to years of manhood in the same village as our late associate, and although he was a few years my senior, our intimacy began at an early age. From that time on, but more especially during the past thirty years, our friendship was of the most cordial and intimate nature. Both in a personal sense and in the business in which our interests were common, we were friends through thick and thin, friends first, last, and all the time, friends in the strongest and deepest and most sacred meaning of the word. If troubles arose, if clouds loomed above the horizon, in times of storm and times of stress, we sought each other for advice and counsel and laid bare our hearts and minds. We did not always agree in our views and we entertained honest differences of opinion. Often we were drawn into, or perhaps I should say indulged in, earnest discussions that we both thoroughly enjoyed and I believe profited by, but in all our lives there was never one word passed between us in anger, never one word that was tinged with bitterness, never one word uttered that left a sting. From 1880 to 1888 it was my privilege to be associated with him in fish-cultural work at Northville, and it was during these eight years that the former close acquaintanceship between Frank N. Clark and myself ripened into a friendship of the most inviolate and sacred character.

Always I entertained great respect for his judgment in matters connected with our line of work, and always I had unbounded confidence in the integrity of his opinions, knowing that he was utterly incapable of duplicity and double dealing, and was never known to be or tried to be on both sides of the same question. And thus it was that I came to know our late associate and to love him, for to know and understand Frank Clark all the way through was to love the man.

Being human he had human weaknesses, temperamental weaknesses, but they were trivial and superficial compared to the depth and strength of his sterling manhood. He lead a clean life because his mind and heart were pure and clean. His robust and rugged strength of character, his moral fibre and the impregnability of his moral stamina enabled him always to stand the acid test of temptation in all of its sordid and grosser forms.

If he erred or chafed or seemed impatient or even intolerant, always it was in opposition to what he conceived to be wrong, and if he sometimes seemed overzealous, always it was in behalf of a cause that his conscience told him was right. Indeed, one of his most sterling virtues and striking characteristics was unflinching courage and an indomitable fighting spirit against that which he believed to be wrong and on the side of that which he believed to be right. He was a born fighter for the right, a born fighter against wrong. These, with his unswerving and unimpeachable loyalty to his loyal friends, and more than all else, the wealth of affection he lavished in unstinted measure on his family and those near and dear, were the dominating influences of his life and the keynote to his character, the character of a strong, honest, moral, clean, and manly man.

If I have failed adequately to express or convey to you my conception and estimate of the character of our late member, if I have failed faithfully to portray his life and personality as they appealed to me and as I knew them to be, I at least have tried not to exaggerate in any way. It has been necessary only to speak the simple truth.

Well may we all hope and pray that when our final accounts are cast up, when the searchlight is thrown on our lives and we are being reviewed and weighed and measured and analyzed, it may be said of us truthfully that we accomplished as much for mankind as he accomplished, that we did as much good in the world at large as he did, and finally, that as many good things may be said of us as may be said truthfully of our late beloved friend and associate FRANK NELSON CLARK.

SEYMOUR BOWER.

PART II

PAPERS AND DISCUSSIONS

FISHERY CONSERVATION*

BY SEYMOUR BOWER

Much is being said and written nowadays about the conservation of natural resources, the mines, the forests, and the products of the great rivers and lakes and seas and oceans, and of their relations with what we may call cultivated resources, such as the products of the soil. It seems obvious that as time goes on and population increases, these earthwide necessities must be produced in ever-increasing volume, and it is equally obvious that this is possible only through the discovery of hidden resources and the constant recreation of current resources on a scale of increasing magnitude. The extent to which these great resources may be drawn upon for current necessities, may be consumed without danger of exhaustion or even depletion, is at once the most vital and complex problem that confronts the human race.

The great resources of the earth, including those that are cultivated and to a great extent under control, as well as those still in reserve in a wild or virgin state, may be divided into many groups and sub-groups, each presenting its own peculiar and widely varying problems, or in some cases practically no problems at all. For example, we need feel no special concern with respect to the precious metals, and perhaps some of the coarser ones, because while the mines that produce them cannot be restored when exhausted, the metals themselves are not consumed or destroyed to any extent, like coal, which is eliminated utterly and eternally when once its stored-up energies have been utilized.

Forests and forestry in their relations to the fisheries and the scheme of things generally, present an entirely different set of problems, mainly because, unlike the products of the

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* President's opening address.

mineral world, they may be reproduced or restored. True, the time required is so long, an average of two or more generations, that timber culture is not an inviting or attractive field for private enterprise. The average man, indeed more than 99 per cent of mankind, must realize on his investments and the fruits of his industry at far shorter intervals than is possible with timber culture. It is practically certain therefore that forests once laid low will be reproduced or restored to any extent only as initiative and control are assumed by states and nations. I think all will agree that mountainous and other regions of public domain ill suited to agriculture but capable of growing some kind or kinds of timber should be set aside for forestry purposes and to perpetuate our springs and sources of water supply. But the extent to which good agricultural lands now timbered should be so reserved, or cleared lands surrendered, is a most vital problem in conservation. Personally I believe that the solution lies in the direction of scientific timber culture, under governmental control or at least under governmental direction. Virgin forests should be utilized and gradually give way to scientific tree culture. There is no good reason why timber under cultivation should not show the same relative increase in results as do other cultivated products of the soil, or as do cultivated and controlled fishery preserves as compared with those that are wild or uncontrolled.

Referring for a moment to the influence of forests over the character and product of the smaller lakes and streams, I believe that we should take broad ground and consider the food problem as a whole and not solely in the interests of these minor fisheries. By this I mean, for illustration—and perhaps some will cry treason—that if a section of timber must be left standing indefinitely and the lands withheld from agriculture, in order to preserve a few trout streams as such, then the timber and the trout should go. On the other hand, timber belts bordering such splendid trout waters as the Au Sable and other rivers in Michigan and elsewhere, should be preserved or replaced, for here the conditions are reversed. The soil for the most part being poor, the actual food value of these streams is much greater than the potential food value of the lands through which they flow.

The fisheries of the great rivers and lakes and seas and oceans present a far different, and in some respects a more difficult, set of problems than the mines and forests. One reason is that, unlike mines that cannot be restored at all, and forests that may be replaced only at long intervals, most species of fish become adults at three or four years of age and are then capable of reproducing themselves or of being reproduced annually. The main reason, however, is that the vast expanses which are their home, nearly three-fourths of the earth's surface, are for the most part in a state of nature. This means that they are in a condition of savagery, subject to no law save that of the survival of the fittest, but it does not mean that we are powerless to amend that cruel law, that we may not in some degree bring order out of chaos, and thus add enormously to the food possibilities of the state and national and international water domains of the earth. Indeed, more than one amendment to this law has already been passed. Perhaps the most important of these modifications is protected or controlled propagation, which multiplies natural hatching percentages a hundred, or, in some cases, a thousand fold. This wonderful increase in the creation of infant fish is accomplished by the simple expedient of insuring fertilization of all of the ova and then protecting those ova from most, if not all, of their natural enemies.

But fish culture in its broadest sense means far more than mere fish hatching, however great importance we may attach to this particular feature of production. Fish hatching solves only one of the many important problems involved in fishery conservation. If we are to utilize the waters to their fullest practicable limit, we must know far more than we do concerning the food, the breeding habits, the range, the enemies, the diseases—in short, the life history and interrelations of all water life from the lowest forms up. Clearly the gigantic task of solving the problems involved in a comprehensive knowledge of water life may be worked out only by the exact and patient and persistent and exhaustive methods of scientific investigation. Every state and nation, all alike vitally interested in the food problem, whether they have direct fishery interests or not, should therefore keep continuously in service a corps of scientists and specialists whose life work is the study and solution of fishery problems. Every lead should be followed out and every clue run down—in short, every minor as well as major problem should be attacked from every possible angle and every point of vantage.

The necessity as time goes on of drawing more and more on the resources of the sea will be apparent when we reflect that we do not need to look so very far into the future to see practically all of the arable lands of the earth occupied and cultivated. True, irrigation will add considerable areas of highly productive soil, and evaporation and drainage and the building of dykes and levees will continue to expose and reclaim many thousands of acres of the most fertile lands on earth, made so by ages of soil wash from surrounding elevations. But, after all, only a small fraction of soil waste in the aggregate may be so recovered. In suspension and solution, the streams and mighty rivers of the earth are annually pouring thousands upon thousands of tons of the most fertile elements of the soil into lakes and seas, where for the most part they are utterly beyond reclamation except indirectly through the fisheries.

Obviously the more the soil is stirred or cultivated the more rapidly does this process of land exhaustion by soil wash go on. With accelerating speed therefore are the water basins of the earth growing richer and richer and the land areas correspondingly poorer and poorer. But this unceasing drainage of elementary food wealth from the soil to the sea does not necessarily mean that it is irretrievably lost, for it is made up very largely of plant food convertible into plant life, which in turn is the basis of fundamental animal life in its many forms. Here, then, chiefly in latent and undeveloped form, is a boundless and increasing store of basic food wealth in reserve. Here are wonderful possibilities in the development of food resources; and more and more as time goes on and soil wealth gravitates to the sea, must the latter be depended on to support the human race. When we shall have learned how, in a measure at least, to direct the development and transformation of the immense accumulations of basic food wealth in water areas, it is certain that the creation of the higher and better forms will be enormously increased, and it is not improbable that the fisheries will then take rank as the most important food resource that the earth affords.

Looking at the situation from a much closer range, however, and in the light of what seems to be the wisest course for the more immediate as well as the remote future, I believe that conservation of resources, in the narrow sense that they should be used with extreme conservatism, should apply only to those resources that cannot be reproduced or restored. "Conservation of resources" is a misleading and deceptive phrase if it means that such of the natural resources of the earth as may be reproduced, as are subject to cultivation, are to be tied up and locked up and withdrawn from use. This class of resources, including the fisheries and forests, in the natural or so called "conserved" state, represents but a small part of their potential value when subdued and developed under a systematic and scientific scheme of cultivation. We should utilize freely but not wastefully, with the obligation imposed always to more than replace whenever and wherever possible, so that current use of natural resources may not mean a net loss but rather a net gain in the sum total of our great earthwide necessities. In view therefore of the enormous potential food value of the water domains of the earth, I believe that this society, as one of the trustees of this vast public estate, should most heartily support and encourage every state and national fish commission, and especially should we insist that scientific efforts be redoubled all along the line, by every state and every nation.

THE CONSERVATION OF OUR RIVERS AND LAKES

By C. H. Townsend

When the President of the United States, about three years ago, created the Inland Waterways Commission and outlined a policy for the development of inland waters which should eventually relieve traffic congestion and benefit the entire country, the people and the press responded with enthusiasm.

When a year later he called for a conference of the Governors of all the States at the White House to consider the conservation of our natural resources in general, he achieved one of the great successes of his Administration. It is doubtful if there was ever before, in the history of the country, such an important gathering of notable citizens.

It is a fact that the people of the entire land realized at once that the prosperity of the nation was dependent upon the conservation of its forest, mineral, land, water, and water-power resources. The word conservation has acquired a special meaning to all patriotic Americans.

The education of the people in these matters had, however, been going on for years, by reason of the activities of our national Bureaus of Forestry, Fisheries, and Irrigation. To their existence and achievements must, in great part, be credited the wholesome awakening of the past three years.

I ask your attention for a few minutes to the subject of our rivers, streams and lakes, and what they mean in connection with our new national word, conservation.

Let us glance at our greatest river—the mighty Mississippi. How it dominates the map of our country! How its tributaries reach out in all directions! With its Missouri branch it is the longest river in the world, except, perhaps, the Nile. Four thousand miles long. It is difficult to realize that the Ohio, the Tennessee, the Arkansas, the Red, and other tributaries that seem so small beside the Mississippi, each greatly exceeds a thousand miles, and all are navigable through an important part of their length. The Arkansas alone is 2000 miles long. It is also difficult to realize that many of these Mississippi tributaries are longer than the greatest rivers of our Atlantic slope. The Hudson, the Delaware, the Susquehanna, the Connecticut, the Potomac, the Savannah are small by comparison, being only from 300 to 400 miles long.

The Mississippi system covers two-fifths of the United States. The region is the heart and soul of the nation's prosperity. With its agricultural development, the United States became independent of the rest of the world. Half of our population is in the States touched by the navigable portions of the Mississippi system.

Who would realize from a glance at the map of Texas that the Brazos, flowing into the Gulf, is 1000 miles long, and navigable in the rainy season for 300 miles? But, then, Texas is of greater extent than most of us realize, being larger than either Germany or France.

A deep waterway from the Great Lakes to the Gulf of Mexico would be of tremendous importance to the economic progress of the country. Its construction is inevitable. The gradual improvement and utilization of all our waterways is inevitable, since the product of our farms alone amounts to seven and one-half billions of dollars a year. In extent and distribution of navigable rivers and lakes, the United States is better endowed by nature than most other countries, yet the rivers are less used.

The neglect of our rivers has led to a national burden; the responsibility rests largely on inimical railway traffic interests, yet greatly on apathetic policy on the part of states and nation. While navigation is the most pressing use for our waterways, there are others of not less present value and future promise.

Another requisite is the physical control of the running waters. Under settlement and cultivation the sward is broken and the forest removed, so that the storm waters gather in torrents, rob the soil of its richest elements, fill the channels with detritus, and build bars and raise floods in the lower courses. In some cases we need reforestation, in others storage reservoirs, in all cases flood-holding and soil-saving agriculture, and in all swifter streams restraint of flow, for the production of power. These are among the remedies which promise control of the running waters, until the rivers are harnessed and turned to human benefit.

Any comprehensive plan for waterway improvement will involve prevention of floods by means of farsighted forestry, intensive farming, and reservoir construction, whereby the waters will be compelled to flow clear as they did before nature's balance between rainfall and forest was disturbed by settlement and industry.

The cost of relief will be large, yet from the standpoint of traffic alone not too large. In addition, the prevention of soil-wash and the purification of the streams will more than balance the entire cost.

A value of running water, not fully recognized, lies in its power, a quantity doubtless sufficient to drive mills and trains and boats, and furnish light and heat and domestic motors after our coal is gone. Hitherto this resource has been much neglected.

The control of the water involves reclamation of arid lands by irrigation and of overflow lands by drainage. Let me give you a few words of Edward Carpenter's account of Chinese cultivation by irrigation:

> In the interior of China, along low-lying plains and great river valleys, and by lake sides, and far away up into hilly and even mountainous regions,
>
> Behold! an immense population rooted in the land,
>
> The most productive on the whole earth. A garden—a land of rich crops, of rice and tea and silk and sugar and cotton,

Do you see it?—stretching away endlessly over river lines and lakes, and the gentle undulations of the lowlands, and up the escarpments of the higher hills;

The innumerable patchwork of civilization—the verdure of the young rice; the somber green of orange groves; the lines of tea shrubs, well hoed, and showing the bare earth beneath; the pollard mulberries; the plots of cotton and maize and wheat and yam and clover;

The endless silver threads of irrigation canals and ditches, skirting the hills for scores and hundreds of miles, tier above tier, and serpentining down to the lower slopes and plains—

The grand canal of the delta plain extending, a thronged waterway, for seven hundred miles, with sails of junks and bankside villages innumerable;

The chain pumps, worked by buffaloes or men, for throwing the water up slopes and hillsides, from tier to tier, from channel to channel;

The endless rills and cascades, flowing down again, into pockets and hollows of verdure, and on fields of steep and plain;

A country of few roads, but of innumerable waterways.

This vast population abides—the most productive in the world.

And all are bound to the earth.

Rendering back to it as a sacred duty every atom that the earth supplies to them (not insensately sending it in sewers to the sea),

By the way of abject common sense they have sought to found on human soil their City Celestial!

But China is largely a deforested country, with much of the cultivated land built up in terraces to which water has to be laboriously pumped. We shall do better than China, for we are already beginning to protect the forests of our hills and mountains, and will thereby secure the perpetual flow of streams, and the engineers of our Reclamation Service have already issued volumes of plans for the impounding of waters that shall flow down plentifully through irrigation canals, upon the arid lands below, until they become gardens and until thousands of reservoirs yield a plentiful supply of fish food.

We have not only disregarded our fresh waters in most of these respects, but we have carelessly permitted them to become polluted. 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.

The great evil with which practical fish-culture in

America has to contend at the present time is the contamination of public waters by sewage and the refuse of manufacturies. Although the propagation of fishes by artificial means has, in this country, reached a degree of efficiency unequaled in other countries, the preservation of streams in conditions desirable for the maintenance of fish life has been singularly neglected.

In a majority of those States which possess fishery resources there exist more or less effective restrictions upon fishing and the operation of fishery industries, but it is seldom that enactments against the depositing of waste matter in the waters are enforced.

All our fish commissioners of experience, both national and state, are agreed that 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 effects of pollution are most serious in the more densely populated states. It begins almost at the sources of streams and extends to the very mouths of the largest rivers.

The conditions would probably not be so serious in their effect upon the supply of fresh-water fishes had not the flow of streams been lessened by deforestation. With the cutting away of forests and the cultivation of the land, the summer temperature of streams has become higher and the breeding grounds of game and food fishes covered by silt washed down by floods.

The pollution of streams not only affects sport and commercial fishing, but the all-important matter of public health.

The agencies at work are almost too varied for enumeration. In general the pollution of waters 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 also the depositing in the waters of cinders, garbage, and trash by the vast fleet of fresh-water steamers everywhere on our lakes. In addition to these sources of pollution there is practically all the city and town sewage of the country. With such facts confronting us there is no need of inquiring why we do not get better results from our admirable national and state fish-cultural work.

The well-known conditions of pollution extending throughout the Hudson River and its tributaries may be found in all rivers of the country where the population is great and the manufacturing industries well developed.

Our whole national system of disposing of wastes is an immoral one; the town and mill can be kept clean, but the condition of the stream itself has been utterly disregarded. 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 waters but valued as fertilizer.

The struggle for the preservation of some of the inland lakes of New York against pollution has been carried on for some time and good results have been secured in several instances. The Merchants' Association of New York City has made a good beginning in its work for the preservation of the Hudson, and it is unlikely that any additional sewage systems will be permitted to pollute the river.

The effects of the pollution of the harbor of New York are liable to become very serious, as the amount of sewage is increasing. There are bottom deposits of sewage in many parts of the harbor that are several feet in thickness. Many forms of marine life which assist in the disposal of organic matter in the harbor must decrease in numbers, and disappear as the volume of sewage increases, while the shad, oyster, and other fisheries are already suffering from its effects.

The keeping of marine fishes in the New York Aquarium has always been difficult on account of the fact that the salt water pumped from the harbor into the tanks is charged with sewage. The water is, in fact, so impure that the death rate among the sea fishes is very high. It has always been quite impossible to exhibit the more delicate marine invertebrates for the same reason. The new system of stored sea water, completed last summer, has given the aquarium complete relief from this great drawback.

The Blackstone is the most polluted river in New England; its name has become synonymous with filth. The headwaters of a river system are usually free from pollution but in this case the opposite is true. The sewage from the city of Worcester befouls the river at its source, and thereafter through its whole extent the Blackstone is a damaged resource to the country. Such is the accumulation of filth in the mill ponds that from some of those near Worcester there arises odors that are detrimental to comfort and realty, if not to health. The use of its water in boilers has long been abandoned and it cannot be used in manufacture of light-colored cloths.

There is no legal justification for the pollution of water, yet so universal is the practice that it has come to receive moral justification at the hands of society, and meets no general condemnation except where it goes beyond the bounds of human endurance. A few states in the Union have recognized the damage arising from water pollution and have made intelligent investigations for the purpose of correcting the evils.

Attention to water supply will dispose of typhoid fever. For the most part American cities dump their sewage into rivers and kill each other. For 700 miles the Ohio River is an open sewer, and for 700 miles typhoid fever rages along it. It can all be stopped—any time the cities along the Ohio River make up their minds to do so.

I am aware that this part of my discourse cannot be pleasant; it is never pleasant to contemplate our misdoings or mistakes, although it may be wholesome.

The safe disposal of our manufacturing wastes and our city and town sewage is at once a problem and a mighty task. In importance it probably ranks first among schemes for stream, river, and lake conservation, since our health and an important part of our food supply are already affected by water pollution. Our fish food amounts to two billion pounds a year.

We will now turn to a feature of our treatment of the waters which is wholly admirable, the work of our National Bureau of Fisheries. This Bureau is charged with the collection of fishery statistics, the scientific investigation of fishery problems, and chiefly the propagation of food and game fishes. Under its direction public fish culture in America has attained great proportions.

The annual output of fish fry from hatcheries in various parts of the country, operated by the Bureau of Fisheries has now reached the enormous figure of something like three thousand millions. The fish cultural work of the different state fishery commissions, taken collectively, yields probably equal numbers of young fry. The governmental part of the work is done from no more than 55 hatcheries scattered over the country—a remarkable illustration of the efficiency of artificial fertilization and rearing of fry. Fish planting in America exceeds that of all other countries put together. Fish culturists from Europe and from countries as far away as Japan and New Zealand come here to study our methods.

The latest statistics gathered by the Bureau for the general fishing industry show that 219,000 persons are engaged in the fisheries; $95,000,000 are invested in vessels, boats, apparatus and other property; and the fish products have an annual value of $60,000,000.

We have no time at present for a discussion of our fishery industries in general. Let us consider a few points of special interest. Evidence is not lacking to show that the long-continued and increasingly extensive fish-cultural operations on the Great Lakes have prevented the depletion of those waters, in the face of the most exhausting lake fisheries in the world. The luscious whitefish, the splendid lake trout, the excellent pike perch may be hatched in such numbers as to assure their preservation without serious curtailment of the fisheries. But the absence of concerted protective measures on the part of the various states has the tendency to minimize the effects of cultivation, and would seem to justify, if not imperatively demand, jurisdiction over the Great Lakes fisheries by the federal government.

In our three Pacific coast states we put three million dollars' worth of salmon into tin cans every year. The magnitude of the salmon fisheries of the Pacific states has required very extensive artificial propagation to keep up the supply.

The Atlantic shad and striped bass have been successfully introduced into our Pacific coast rivers. Viewed from the purely business standpoint, the transplanting of shad to the Pacific has been a remarkably good investment. From the best information obtainable, the entire cost of the experiment was less than $4,000, while the aggregate catch for market in California, Oregon, and Washington to the end of 1907 was approximately 15,000,000 pounds, for which the fishermen received $300,000.

The economic importance of the introduction of the striped bass on the Pacific coast may be judged from the fact that the entire cost of transplanting was less than $1,000, while the value of the catch to the end of the year 1907 was about $900,000, a sum representing a yield of more than 16,000,000 pounds.

We may for a moment consider certain of our game fishes in connection with our recreation and our summer-resort industry—the latter really seems to deserve to be ranked as an industry.

The latest government statistics respecting the quantity and value of fresh-water game fishes sent to market in the country show that the annual catch amounts to fifty-five million pounds valued at more than two millions of dollars. It is well known, however, that these figures do not, by any means, represent the real value of such fishes to the country, since the numbers taken by anglers are not accounted for. The catch of game fishes for sport is very large and the value of some of our northern states of good angling waters is well recognized.

It is claimed that more than 130,000 persons visit the State of Maine every year on vacation, to fish or to hunt. These summer visitors bring into Maine from six to twelve millions of dollars a year, or more than thirty per cent of the total value of all farm crops raised in Maine.

Many of the northern states, notably Michigan, are visited in summer by legions of tourists, largely on account of the good angling to be had in their waters, and the lakes of all America have become summer resorts for an important proportion of the people.

The time allotted to me will not permit of more than this hasty glance at the conservation work of our splendid national and state fishery departments. Enough fish fry go into the water annually to make the finest of commercial fishing and angling in a very few years—were our streams and lakes protected from pollution, and otherwise conserved in accordance with their importance to our civilization.

DISCUSSION

Mr. Frank N. Clark, Northville, Mich.: Some twelve or fifteen years ago, at our Niagara meeting, I presented a paper a little along the line of Dr. Townsend's paper—touching upon that line, at least—and I have been a great enthusiast since that time, not in preparing anything further but in reading, studying and thinking.

I think that the time has come for this Society in some way to put itself on record, perhaps somewhat as we did two or three years ago, in regard to the international regulation of fisheries. I really think that if the Society could take some action by resolution that could be scattered broadcast it might do something in the way of encouraging the states and the national Government to further steps toward the prevention of the pollution of the waters.

There is no question at all but what Dr. Townsend's paper this morning and our President's paper also touched upon a subject that the fish culturist and the scientist must keep in mind if they are going to increase the fishes in the waters. I have been hatching fish over forty years, and the question of merely hatching fish today is nothing but a question of machinery. We give Mr. Downing a stated number of whitefish this fall, tell him how many whitefish he will have penned up or ready to take eggs from and Mr. Downing will tell you within 5 per cent how many he will return next spring—just as your factory does. But though we can hatch the fish and place them in the water, if the water is polluted all the fish culturists in Christendom cannot make it productive. What is the use of hatching 500,000,000 of whitefish—and it is more than that in both the Dominion of Canada and the United States—what is the use, I say, of hatching those fish and putting them in water that we ourselves (I am owning up today) know is polluted? And how are we to wake the people up to this fact?

As I have said before in this Society, in Thunder Bay on Lake Huron, a bay that used to be teeming with whitefish, the feeding ground of the whitefish, today you cannot find a whitefish. That is a bay nine miles out from the river and whitefish used to be caught in Thunder Bay River.

Now we must put a stop to this. The bottom of Thunder Bay today is covered anywhere from one to ten feet deep with refuse. The case is, of course, different outside in the lake, and plants of fish count there. But we cannot get rid of the pollution in Thunder Bay.

Now it seems to me, as I said, that there ought to be something done. And it also seems to me that if this Society can go on record good and hard, some way so that it is plain we mean it, we might thus help the state and the national Government to take some action. I do not know just how it is going to be done, but it has got to be done or we are never going to take our fish in the lakes.

Mr. W. E. Meehan, Harrisburg, Pa.: I am very much interested in this paper of Dr. Townsend's, and a few weeks ago when the committee met it was understood that he was to make a speech and I was to follow in respect to the work that has been accomplished in Pennsylvania, with regard to the State of Pennsylvania and the interests of the adjoining states. My remarks have been put in the form of a paper, and I am embarrassed in the discussion of Dr. Townsend's paper because anything I may say now will be largely a repetition of what I have said in my paper. There is one fact, however, that I might touch on, and that is the Ohio River, to which Dr. Townsend has referred.

The pollution there has been so bad that fish have been destroyed by the millions, and about a year ago a conference was held in Pittsburg between authorities of Ohio, West Virginia, and Pennsylvania, and the United States Bureau of Fisheries. The result was that a resolution was adopted recommending that the States of Ohio and

West Virginia enact a law on the question of pollution identical with the law that is in force in Pennsylvania, and a copy of that resolution was also given to the United States Bureau of Fisheries with a view of having Mr. Bowers present that same bill to Congress. I believe that Mr. Bowers is going to do that at this coming session of Congress. I heard so indirectly.

But there is no doubt but that this has become a big question and a live question and one that this organization must of necessity take part in to see if something cannot be done. There is little use in putting fish in a stream where the water has been so badly polluted that even vegetable life is destroyed.

Mr. S. F. Fullerton, St. Paul, Minn.: I do not think anyone present is more delighted than I am at the trend that things have taken. I have always contended that protection and propagation ought to go hand in hand. Here is an example: Two valuable papers have been read by our President and Dr. Townsend, identical in tone.

I come from Minnesota where the Mississippi rises, where I have jumped across the river many times, at Lake Itasca. I have lived or the banks of the Mississippi near Minneapolis and St. Paul, and I think the Mississippi down to Wabasha would be the greatest bass stream in the world if purified. I have made a study of the subject, and can state that the fish have been disappearing simply on account of the pollution. It is not necessary to say that this Society ought to go on record against pollution; but we must follow that up and work on our legislators and our Senators and Congressmen, and impress on them the necessity of stopping this pollution. We can do it; there is no question about it. This Society is a strong society, and its members are men of influence generally in the community in which they live; and if everyone leaves this meeting determined to do something in addition to passing a resolution, the time will come when we will have our waters pure.

Dr. B. M. Briggs, Brooklyn: I want to speak in favor of old ocean. It does not appear to have many advocates. The streams and ponds have many advocates but the salt water and the millions of New York people are left to take care of themselves. Now the ocean is getting polluted. We cannot catch fish as we used to in New York Bay. You must go past Sandy Hook. Last Saturday we had to go to Fire Island before we could catch fish. The water is getting polluted and New York has got to take this matter up and stop it. The Croton water is foul smelling and bad tasting today due to vegetation, and the presence of that vegetation is due to the upsetting of the balance of nature by not having fish enough where the waters come from to eat up the vegetation. The water is hardly fit to drink, and in years to come it will not be as good to drink as it is now.

But what I am specially interested in doing is to propagate fish for the people of New York. I think the United States Government should use each life-saving station to propagate fish. Owing to the improvement in vessels wrecks are not as frequent as they used to be and the life savers, who are most carefully selected men, have become simply patrol men. They would be glad to help in this matter, and each station should be given these new duties.

Look at the cod fishing about New York. Cod come back to where they were born as the salmon do. There is not a cod egg put in around New York and yet cod are being taken out in great quantities. The same with sea bass and all the rest of the fish.

Dr. Tarleton H. Bean, New York: There seems to be some mistake about the planting of codfish and catching of codfish around Long Island. I believe there is a gentleman in this Aquarium who has seen cod seined in Gray's Inn Bay. The station at Cold Spring Harbor, Long Island, has planted codfish, not last year, but in previous years, and is ready to continue that work just as soon as the powers that be will grant the necessary appropriation for the purpose. We cannot do it without money.

FISH-CULTURAL POSSIBILITIES OF THE NATIONAL PRESERVES

By D. C. Booth

Among the later innovations in government administration has been the withdrawal from entry and setting aside of vast tracts of land in various parts of the country for forest reserves, for the preservation of objects of historic and scientific interest, for the protection of fishes, song and game birds, and big game, and for the benefit and enjoyment of the people. Although new in the United States, this has been a well settled policy in many foreign countries for a comparatively long period. It had its inception in a desire to prevent ruthless waste, to develop the resources, and to preserve to the people an empire of immense possibilities which might otherwise fall into the hands of private ownership for spoliation, aggrandizement, and personal gain.

These reserves, small at first, have been augmented from time to time by presidential proclamation until now they comprise the stupendous total of over two hundred million acres, an area several times larger than all the New England States and nearly equalling the combined extent of all the states bordering on the Atlantic coast. These reservations and their ultimate uses are not of state or local interest solely, but are of national concern; and their administration, development and protection should remain under federal control. At the present time, several bureaus in the Departments of Agriculture, Commerce and Labor, Interior, and War are working in harmony for the development, improvement, and protection of these reservations and conserving their phenomenal resources for the whole people. There are in all two hundred and thirty-six reserves, located in twenty-four states and territories, of which twelve are national parks, twenty-three for the preservation of objects of historic and scientific interest, fifty-one for the protection of birds, and one hundred and fifty for forestry.

Within this vast empire, the principal rivers of the United States have their sources in a marvelous network of ideal trout streams. They are considered ideal from their very location in the mountains or higher elevations of the surrounding country, beyond the evil effects of an over-civilization, where they are free from pollution and their rapid fall and environment make them the natural home of the game trout. These reservations, containing some of the grandest mountain, forest and river scenery and much of the best big game hunting and fishing, are being each year made more accessible by substantial improvements in the way of macadamized roads, telegraph and telephone equipment, and modern hotels, thus eliminating many of the rougher phases of camp life.

During the past year over five hundred thousand people, representing every country in the world, visited these reserves for health, pleasure and recreation. Under such conditions these places are destined to become the great playgrounds of the American people. With some of them, especially Yellowstone National Park, the writer has been closely identified during the past decade, having personally conducted the first fish-cultural operations there and been in active charge ever since. Previous to the efforts of the Bureau of Fisheries a large portion of Yellowstone National Park was destitute of fish life, while now it offers probably the best game trout fishing in the country and is frequently mentioned by enthusiastic writers as the angler's paradise. Here is located the greatest game trout station in the country, where millions of eggs are each year collected, eyed, and shipped to supply various federal and state hatcheries less favorably situated and to applicants in many states. Over eight million eggs have been collected during a single season.

Although Yellowstone National Park was set aside as a government reservation in the early seventies, practically all the improvements have been made during the past ten years. Here the traveler, upon alighting from the train of solid Pullmans at the boundary line, is met by tally-ho coaches of the most modern type, in which he tours the park for days over a perfectly macadamized road, sprinkled daily, with hotels at convenient distances on the way whose architectural beauty harmonizes with their surroundings and whose management would do credit to a large city. While a guest at one of these hotels with the conveniences of modern life, the traveler can hardly realize that he is in the very heart of the Rocky Mountains until he is forcibly reminded through the sudden appearance of several kinds of big game within a few feet of the hotel porches. Yellowstone National Park is thoroughly policed by four troops of United States cavalry besides civilian scouts, regular employees of the Interior Department, and it is needless to say that the fishes, birds, big game, and scenic beauties are well protected. While seemingly alone in its wonderful geyser phenomena, as a game preserve Yellowstone National Park may be considered as fairly typical and affords a striking example of the wonderful possibilities of the other national reservations.

Wild game and fishes have always been and are today considered the property of the state in which found, but the inadequate protection afforded them is often a very discouraging feature to the enthusiastic fish culturist and is not comparable to the protection under federal control. At the present time these reserves offer far better hunting and fishing than the surrounding territory and they are a substantial benefit to every state near which they are located because they furnish a nursery for game and fish for the continuous replenishment of other sections.

CONSERVATION OF FOREST LIFE

By Richard E. Follett

I have been invited to entertain you with motion pictures and incidently to say something regarding the importance of conserving our forests and forest life. I will proceed at once by showing you salmon fishing with rod and line in Canada, on the Nepisguit and Tobique Rivers, two well known salmon rivers in New Brunswick. These rivers take their source near the southern boundary of Restigouche County, flowing in opposite directions. The Nepisguit runs eastward and discharges into the Bay of Chaleur, and the Tobique flows westward, discharging into the River St. John. [Motion pictures showing the capture of about twenty Atlantic salmon were then exhibited.]

It is no easy task for me to address the members of this time-honored American Fisheries Society; however, the knowledge that you are all deeply interested in the conservation of forests and forest life, together with the fact that you fish conservators have done more during the past thirty years or more toward conserving valuable fish life than all the other agencies combined, makes my task less arduous.

We cannot have salmon rivers or good trout streams without forests. All salmon rivers are forest-fed rivers. All living streams, except those in glacial regions, are sustained by the run-off underneath the surface which is largely held and supplied by the forests. At present, we are consuming our forests three or four times as fast as they reproduce, and our forest area has been reduced to practically one-half of its former area. Our fish, game, and other forms of forest life have been reduced to a far greater extent during the last century.

We are taking from forest waters each year more than $23,000,000 worth of food fish, nearly one-half as much as is furnished by the game; and from $7,000,000 to

$8,000,000 worth of raw furs are exported yearly, together with as much more used for home consumption.

Our forests not only sustain and protect the wild life, which includes the salmon and trout in the rivers, as well as the deer and birds in the forests; they hold the soil and conserve the waters; they protect the fertile lands from droughts and floods, and work against excessive heat and cold; they sustain and protect the general fish life in our lakes and streams. I believe that soil erosion, due to deforestation, was the final cause of the disappearance of salmon in Lake Ontario and its tributaries where they were once so abundant.

President Taft in his January message stated that millions of acres of public lands had been fraudulently obtained and the right to recover such lands had long since ceased by reason of statutes of limitation. We all know that nature has her statutes of limitation; the disappearance of the passenger pigeon is a striking illustration of this. Only a generation ago, pigeons existed in countless millions. I am sure that they were adaptable to domestication and cultivation, and I believe that they might have been saved had the work of cultivation been taken up in time. Let us take another viewpoint in order to get at the real value of our forests and forest life.

I have been told today by Mr. Brackett, the commissioner of Maine, that the outing business in his state amounts to more than $20,000,000 per year, that is, the money spent by the people who go into the woods, the fishermen, hunters, and tourists. There is no commercial fishing permitted in the inland waters of Maine, therefore no part of the $23,000,000 worth of food fishes before mentioned comes from these waters of Maine or, in fact, from any of the inland waters of the New England States, because commercial fishing is not permitted there, and the river fisheries which once produced shad and salmon in great quantities are now, comparatively speaking, valueless, owing largely to excessive stream pollution and deforestation.

No people on earth have been so wasteful as our own people; only a century ago, or three generations past, ours was the richest country in the world in forests, fish, game, and other natural resources, which had been accumulating for untold ages. Each generation has taken from the forests, from the rivers, and from the seas all it could possibly seize upon, recklessly indifferent to future consequences.

It has been said that things must become intolerably bad before they can be bettered, but have we not already arrived at a condition to cause alarm, which must arouse sentiments of public duty and responsibility sufficient to overcome this present indifference, and to check this inconsiderate greed and selfish desire to consume and destroy these gifts of nature which we hold in trust for ourselves and our descendants? If, regardless of our duty, we continue in our improvident course, we shall bequeathe to another generation a further wasted and impaired inheritance, and our own neglected obligations cannot be discharged by others upon whom we shall have laid these burdens. Is this fair? Is it a square deal? Is it fair to our children and to the children yet unborn?

DISCUSSION

Dr. B. F. Briggs, Brooklyn: I liked those pictures and was made enthusiastic by them. Yet, think how far you have got to go in order to enjoy such scenes, while within half an hour's ride you can catch weakfish in Jamaica Bay—just as lively a fish as you could want. And if we will propagate them there see what the millions of New York can do. They can enjoy that fishing as only a few do now. This year we have been able to stop net fishing in Jamaica Bay almost entirely. The result is that anyone can go down in half an hour on the South Bay and enjoy all this that you have seen before you.

NOTES ON BLACK BASS

By Tarleton H. Bean

I have no formal paper on the black bass, and do not consider it necessary to take up your time by any attempt to read an exhaustive essay on that species. You have merely to refer to the "Manual of Fish Culture," of the United States Bureau of Fisheries, to Dr. Reighard's, Mr. Lydell's and other papers in state reports, as, for example, the reports of the Wisconsin Fish Commission, and to Dr. Forbes' "Fishes of Illinois," to obtain a history of the black bass, its habits, distribution, food, breeding, etc. I have here merely a few scattering notes gleaned from a very busy fish-cultural experience in New York State, the first of them relating to the transfer of gravid bass from wild waters to breeding ponds.

Not very many years ago it was thought that to handle a black bass within a day or two, or even within a month or two, of its spawning season meant that the fish would not spawn during that season. I believe I have told some of the members of the Society that we have demonstrated, at least at Constantia and at Bemus Point, on Chautauqua Lake, that this is not strictly true, because our men have taken bass just on the point of spawning, have transferred them from Lake Oneida and from Chautauqua Lake to the hatchery ponds, and have had them begin nesting just as if nothing unusual had happened. This has occurred two or three times over with bass from Oneida and Chautauqua Lakes. It is an important item for consideration. I would not for a moment recommend that everyone should defer the transfer of bass to breeding ponds until a short time before the spawning season opens, and yet there are some very good arguments in favor of that method, among them being the saving of winter losses and the cost of feeding, which are especially important.

Adult bass were caught in Oneida Lake from May 21 to May 26, 1908, were placed in the ponds at Constantia and commenced to nest at once. From fish taken in Oneida Lake in 1909, 100 adult small-mouth bass were carried to Linlithgo Station, a distance of about 160 miles, and involving a fatiguing journey; and yet Mr. Winchester reported that they adapted themselves to the changed conditions satisfactorily and began to make their nests after a few days. The results of their spawning were good. After the spawning season 100 more were brought to Linlithgo from Oneida Lake. At the Chautauqua Hatchery the first experiment in hatching small-mouth bass in a pond was made at Bemus Point. Adult bass caught in Chautauqua Lake were placed in Becker's Pond, near Bemus Point. The fry resulting from their nesting were estimated at 50,000. They were carried to fingerling size without artificial food, and with very small loss. This experiment shows the practicability of getting a good average hatch from a small number of bass after transferring them suddenly from open waters to a rather small pond. On July 25th some of the young measured two inches in length. The dark bars on the sides of young bass are developed much earlier at Bemus Point than at Constantia. At Bemus Point bass about one inch long have nine or ten conspicuous dark bars on the sides; but at Constantia the bars do not appear until the fish are considerably older.

On July 2, 1909, Mr. George F. Scriba, foreman of the Oneida Station, took two nests of black bass containing 15,000 fry from one of the hatchery ponds. In the same year Mr. G. Dexter, of Utica, wrote to the New York Commission that two bass caught at Lewis Point, in the western part of the state, were full of eggs. I mention this circumstance to show that the law does not protect the black bass through the whole of its spawning season, although the intention was to protect it during the entire period.

As to natural food of the bass, at the Linlithgo Station, in Columbia County, in 1910, the young were fed chiefly on the fry of the river alewife which were introduced for their food. There were also in one of the ponds great swarms of the larvæ of a black fly (*Simulium* sp.), and it was really wonderful to see the little fish come and feed on these larvæ from the hands of the keepers. They lost all fear, so fond did they become of the taste of this larva. This is only one of many natural foods which go to help out the supplies of the fish culturist, and very effectively too. The use of young alewives was one of the most fortunate expedients ever tried at Linlithgo. I have seen small bass in the wild state at Linlithgo feeding freely on the young of the common chub and other minnows.

The growth of the young varies greatly with the conditions. On July 1, 1907, at the Oneida Station, Foreman Scriba had 6,000 fry in the hatchery tanks, where they did not grow and apparently took very little interest in food. They were soon afterward transferred to a large bass pond where they had plenty of natural food, and their rate of growth was much more rapid than in the cold water of the hatchery.

At the Oneida Station small-mouth bass are very irregular in feeding. On some days they rush to the surface of the pond eagerly to receive food thrown to them, and they come into full view near the shore, but on other days they feed little or not at all, although live frogs will always tempt them. The adults prefer the chopped flesh of the pickerel because it is white and firm. Suckers are also eaten, but not so freely.

The disastrous effects of sudden changes of temperature upon the young cannot be too strongly emphasized. At the Oneida Station in 1910 some bass almost a year old were taken out of the pond and put into one of the hatchery troughs where the water temperature was perhaps 10° lower. Within a few days I found a very remarkable state of affairs among these fingerlings. They had been subjected to this cold water only a short time; yet nearly all of them had been attacked by a small flagellate parasite, one that is especialy hurtful and causes more gill inflammation in young trout and other young fish than any other parasite known. Nearly all of the bass had this parasite. Many individuals had under the skin the larvæ of a flatworm, which, as you know, does not do great harm because the fish is not the final host of the worm. A few bass had in the eyes what the Germans call *Saugwürmern,* nematode larvæ, to the number of perhaps 200 or more, causing blindness.

This condition was observed some years ago at the Oneida Station in the trout perch and other fish. The trout perch is one of the most valuable natural foods of the pike perch. A number of young bass had these nematode larvæ in the eye, flagellates in the gills, and also distomes making little black specks under the skin. At the Oneida Station young black bass, yellow perch and a half dozen other species which run up the creeks from Oneida Lake in the spring are frequently attacked by this larval worm which invades the eye. Hofer describes a species which produces the same effect in Germany. This condition was not observed in Scriba and Frederick Creeks, at Constantia, until 1902, although it existed earlier. It lasts until freezing weather sets in and affects all kinds of small fish, but is not seen in large fish. The disease begins suddenly and destroys the eye in three or four days. It has never been observed in the creeks mentioned above the dam.

No study of this disease has yet been made from suitable material. Mr. Marsh saw some examples from Constantia in 1906, but was unable to decide whether the disease was of bacterial origin or not. The condition may have arisen subsequent to the original attack of the parasite. The disease has not been studied since 1906, but I think there is now no doubt now that the larvæ of one of the nematodes cause the blindness.

In June, 1905, a bass caught in Culver Lake, New Jersey, was received for examination. All of the viscera of this bass were incased in a mass of cestodes, forming a sheath around certain organs, but without destroying the vitality of the fish. Prof. Edwin Linton identified the larva as a species of tapeworm, and since the receipt of the specimen referred to, other individuals have been forwarded and found to contain the same parasite. The bass is an intermediate host of this worm, the final host being some species of water bird. It is important to keep all lakes and ponds free from aquatic birds, as they are related to many troublesome internal parasites of fishes.

This same condition of parasitism in black bass has been observed in the lakes of Toronto, Canada, where C. W. Nash found it. He says parasites infest fish in what are known as "drowned lands" particularly, and he is inclined to believe that the presence of decomposing vegetable matter is necessary to their existence.

In the summer of 1909, Judge Joseph I. Green, of Long Lake, sent for investigation a "grubby bass" caught in the vicinity. The parasites were under the epidermis and were evidently related to the *Diplostomum* species, described by Dr. Hofer in his *Handbuch,* page 138. Dr. R. S. Ware, of Hague, N. Y., informed the commission in August, 1909, that black bass caught that season in Lake George were very frequently infested with a worm of the *Taenia* type.

Black bass fry numbering 57,000 were placed in a small retaining pond at Constantia in 1908, and nearly all of them escaped suddenly. The pond was examined and found to contain numerous borings of about the size of a lead pencil or larger in the bottom and sides through which the fish escaped into Frederick Creek. These borings were made by worms and crawfish which traveled more than 50 feet through the earth from the creek to the pond. Crawfish, worms, meadow moles, skunks, and muskrats play havoc with the embankments of ponds at Constantia.

In the Adirondack region the presence of black bass involves the loss of other fish. For example, frostfish are becoming very scarce in the Fulton Chain of lakes, and Foreman Burke thinks the bass are destroying them because the lakes which contain no bass yield as many frostfish eggs as ever.

We have, near Albany, a number of very nice little fishing lakes, among them Nassau Lake, 16 miles distant, which is a great resort for fishermen. I happened to be there during the time when the lake was in bloom, and pushing around in a boat hunting for the bass, I discovered that it was useless to go into any portion of the lake in which the bloom had accumulated. Wherever I could find a lee shore from which the wind had swept off the bloom, I could catch bass and nowhere else in the lake during that period.

OBSERVATIONS ON THE SMALL-MOUTH BLACK BASS IN PENNSYLVANIA DURING THE SPAWNING SEASON OF 1910

By W. E. Meehan

All small-mouth bass distributed by Pennsylvania for stocking purposes are obtained from two sources, to wit: From fish reared in captivity in the state hatcheries and from wild fish in some of the lakes in the northeastern part of the state. The work of bass culture this year was very discouraging in Pennsylvania both at the hatcheries and in the field. From both sources less than 300,000 advanced fry were secured while under normal conditions there should have been 1,000,000. The results in the hatcheries were better than those in the field proportionately as about 200,000 were reared of the 300,000 output. The cause of the poor result was a very rapid fall in the water temperature before the eggs of the small-mouth bass were all hatched. The unfavorable water conditions continued for more than twelve days, during which some very interesting observations were made with respect to the eggs, fry and the actions of the parent fish. Some of the observations merely confirmed things which we already knew, others were novel to us. The ponds at the hatcheries being shallow the temperature was neither as low nor as long continued as in the lakes, and with the better protection that could be given the fry in the former places there was naturally a greater proportion of fish saved than from the natural lakes. The 200,000 small-mouth bass distributed from the state hatcheries were reared at two stations and the 100,000 from the field were gathered from four lakes. The field work was on eight natural ponds. In four of the eight lakes the water temperature was so low throughout the entire season that until June 18th when the field work ceased not a single nest had been cleaned up or an egg deposited.

The fish began to clean their nests in the other four lakes about May 20th, the water temperature at the time being 56°. Altogether, by the 1st of June there were nearly four hundred nests either with eggs or ready for them. Indeed the fish were hatched in perhaps fifty nests.

From May 20th until June 1st the weather while not cold was mostly rainy and cloudy and the water temperature varied between 56° and 58°. There was a sudden change in the weather June 2d. That night there came a cold snap with frost sufficiently sharp to kill young leaves of trees. While there was frost only one night the weather continued very cold until June 12th when it gradually moderated, but did not become warm until the 16th. By June 5th the water temperature in the four lakes had fallen to 48° and it remained about that point until the 12th of June. The lowest point recorded was 46°. Between June 12th and 16th the water temperature rose gradually to 58°.

Simultaneously with the fall in the water temperature every nest that did not contain eggs was promptly abandoned by the parent fish. An examination on the morning of June 4th of the nests showed that the unhatched eggs had assumed a dullish color. By the following morning fungus had developed, and within two or three days every egg had disappeared, probably devoured by small fish. The parent fish abandoned the nests containing eggs as soon as fungus developed. A constant inspection of the nests containing fry showed that the young fish clung closely to the bottom without any sign of motion, and for the next week there was very little absorption of the sac visible, and at the end of ten days the sac was hardly more than half absorbed.

While there was no apparent activity among the fry in many instances they actually did move and at the end of ten days the fish in nearly half the nests had scattered over a radius of ten feet or more. In this connection there was one very curious incident. On one lake under my own charge there were three nests about six or eight feet apart and on a sloping bottom. All the fish from one of the lower nests abandoned that nest and worked their way into the nest higher up and nearer shore where they were promptly adopted by that fish. The parent bass owning the abandoned nest took the desertion philosophically and departed without interfering with the other fish. In the case of the third nest the young fish scattered for some distance, many going into deeper water, but, as far as I could ascertain, none joined the united colonies close to shore.

On the morning of June 12th I noticed breaks in the water over a few of the nests and an investigation showed that it was the parent fish rising to insects. Before the day was over more than half the bass having nests on one of the lakes were rising. This was interesting to me because of an impression that during not only the incubation period but while caring for the young the old bass did not feed. A clear explanation of this curious incident was apparent the next morning. In every instance where the bass had risen to insects the day before it was merely preliminary to their abandoning the young. Seemingly the bass finding that the young still had their sac unabsorbed at the end of ten or twelve days, became tired and left the young fish to their fate. In the majority of these instances the little bass found their way into the maw of the yellow perch, sunfish and other species. It was not until June 14th that any fish rose sufficiently to be taken in the nets. Those that were taken were very small but were unusually strong. A peculiar feature also was when they did begin to rise they did not seem to be affected by the setting sun but remained swimming well above the nest at least until there was no light and we scooped advanced fry until darkness drove us away. When the water temperature reached 57°, which was I think on the 14th, bass in all the lakes began rebuilding nests, and by the 16th each lake had from 25 to 50 nests all of very large size and filled with eggs. The eggs were unusually large, nearly half larger than normal. They were also of a pronounced orange tint. Had I not actually seen the bass on the nests I would have declared the eggs were not bass eggs. These eggs, however, were of very poor quality, very few hatched, and the fish that did issue therefrom were weak. This was doubtless due to the warm weather that succeeded the cold spell and which drove the water temperature up rapidly.

A peculiarity of the nests cleaned up early in the season was the large number of very small diameter, and also a number that apparently were cleaned in a hurry and eggs deposited thereon before completion. Some of the nests were so very obscure that the searchers only came upon them by accident. Another peculiarity was the considerable number of nests close together. On one pond under my special charge there was a stretch where the nests in no instance were more than ten feet apart, and there were several places where three and four nests were finished close together with not more than one or two feet intervening. They were as close together as sunfish nests often are. The observations made by me and my men confirm what has been quoted before, that bass cease cleaning up nests and depositing eggs when the water temperature falls to 55°, that eggs will be killed when the water temperature lowers to 45°. It also demonstrates that bass, even in a wild state, do not necessarily build nests far apart. It also indicates that with rapid rise of temperature bass eggs are as of poor quality as shad eggs under the same conditions, and finally that the parent bass will not watch and care for their young many days after the normal period.

INCREASING AND INSURING THE OUTPUT AND NATURAL FOOD SUPPLY OF SMALL-MOUTH BLACK BASS FRY, AND NOTES ON COMBINATION OF BREEDING AND REARING PONDS

By Dwight Lydell

SPAWNING CONDITIONS

In speaking of the habits of the small-mouth black bass, I have often said before this Society that I think it necessary for every fish culturist engaged in the propagation of small-mouth black bass to work out his own salvation, according to the locality and surroundings of his station.

I do not think any fixed set of rules can be laid down which will work out successfully in every latitude and location, therefore I think some of the following notes may be of interest to those engaged in the breeding of the small-mouth black bass, and may apply to work farther north or south as the case may be.

The conditions at the Mill Creek Station, in Michigan, are such that if the parent bass are placed in the ponds early in spring and left to spawn, we lose about one-half of the fry, and sometimes nearly the whole spawning is a failure; this is caused by the sudden changes in temperature which occur.

The stream from which we derive our water supply flows several miles through open country and is very shallow, therefore two or three warm days or even one will warm the water to a point where the male bass feels that he must prepare a nest for his mate; the result is he often gets this done and he and his mate cover their nest with eggs. Then a cold night or two, and possibly a couple of cloudy days follow and the temperature of the water falls from perhaps 65° to 45°, and all the eggs that have been deposited previous to the cold snap are lost; then the fish desert their nests and all is confusion.

Previous to three years ago at the Mill Creek Station we were never sure that all eggs deposited would produce fry, owing to the conditions which I have just described. This uncertainty in regard to results would sometimes be very trying; then it occurred to me that possibly some way could be devised whereby the fish might be prevented from spawning until all danger of cold snaps had passed.

The plan finally adopted is to place all the breeding bass in the wintering ponds, which are deeper than the others; this is done in the late fall and plenty of minnows are introduced to feed them until the spawning season the following spring. In spring a large supply of water is turned on and is kept as cool as possible by adding what spring water is available at the station. In these ponds the fish have no nests or other places to spawn, and they are too crowded to spawn, even under more favorable conditions. They are held there until all danger of the spawn being destroyed by cold weather is past. In the meantime the spawning ponds have been prepared, nests placed, and everything put in readiness for the breeders. When spawning cannot be postponed any longer the fish are sorted and placed in the spawning ponds. The fish cover their nests with eggs within 24 hours after being transferred. During the past three seasons this plan has worked so successfully that no poor nests have resulted, and every nest has been productive. I think possibly this plan could be carried further by separating the males from the females; then there would be no chances for them to spawn.

I know from an experiment carried on at the Mill Creek Station that a bass may hold her eggs until some time in July. One season, having about fifteen surplus females, I placed them in a pond by themselves. They were seined, and one of them was opened about every ten days from the middle of May until the middle of July. The ova were found to be in good condition until the last seining, which occurred on July 17th, when they were seen to be sloughing away. The new eggs were all formed, and no apparent harm had been done to the fish. The male bass, no doubt, would not be in the pink of condition so late in the season, but I think it possible to keep them back for at least ten days after the first lot has spawned. This can easily be done by placing some of them in a cold spring-water pond early in the season.

At the Mill Creek Station we have had two separate spawnings of the small-mouth bass for the past three seasons. Immediately after the first fry had risen from the nest and commenced feeding, they were removed from the fry retainers and the latter were taken from the pond. Fresh males were then introduced and spawning occurred again, as about one-quarter of the nests had eggs on, but there were not as many eggs per nest as from the first spawning.

A female bass does not necessarily deposit all of her eggs at the first spawning; it all depends on the male. When he is through he drives her away regardless of her desire to stay longer. What eggs she has not deposited, or most of them, may be secured by introducing a fresh male, as previously described, or perhaps some other male that had his nest ready at the time the first male drove her away will mate with her and secure the balance of her eggs for his nest. What has been said of the female bass may also be said of the males to the extent that they will have two, and I have known of one instance where a male bass fathered and brought off three separate schools of fry in one season. In one pond during the past season five males out of seventeen brought off the second school, in another pond seven out of eighteen, and in another three out of nineteen. This occurs only where the first lot of fry is taken away immediately after it has risen and commenced feeding.

Experiments carried on along these lines at the Mill Creek Station the past season lead me to believe that it will be possible to produce at least one-third more fry from the same area of water than we now do, simply by having in a pond, fed with cold spring water, where possible, a surplus or extra supply of male and female bass to draw upon, these extra bass to be introduced into the regular breeding ponds immediately after the first fry have been removed.

FOOD SUPPLY

The food supply for the fry of the small-mouth bass at the Mill Creek Station is principally Daphnia, belonging to the family of water fleas. The supply is limited in the ponds that are left in their natural condition during the whole year, but almost unlimited in ponds that are drawn down and left nearly dry from the middle of September until the ground is frozen. In ponds so treated the past two seasons we reared to the No. 1 fingerling stage six times as many bass as we did in another pond of the same area and not thus exposed. Great clouds of this food could be seen apparently rolling along, having the appearance of roily water. By taking a boat and going out on the pond and looking down into the water the bottom seemed to be carpeted to the depth of an inch with Daphnia. Later in the day, if it was warm, this food would rise and distribute itself through the water. In one pond 150 x 364 feet, treated as above, we reared 30,900 No. 1 fingerlings; 25,200 No. 2 fingerlings, and 3,000 No. 3 fingerlings of the small-mouth bass, and in another pond of about the same area 100,000 large-mouth were raised to the No. 1 fingerling stage.

CONSTRUCTION OF PONDS

A great deal of thought has been given to the construction of a pond that would better serve the purpose of both breeding and rearing bass. Of course, we know that adult bass prey upon the young to a certain extent, especially when the adults do not receive a certain amount of food every day. The plan finally decided upon was to construct a pond with two terraces, the first one extending from the shore into the pond a distance of ten feet and having six or eight inches of water, the second terrace also ten feet wide and with about two and one-half feet of water, whence the bottom gradually slopes to the kettle or deepest part of the pond. This experiment was tried on one side of one of our ponds, the opposite side being left in its natural shape, that is, starting with a feather edge and gradually sloping to the deepest part. This was done to decide whether we derived any benefit from our experiment. The result was that two very important difficulties were overcome: First, the nests being placed on the deeper terrace, the spawning bass were never disturbed by people strolling around the ponds; and, second, the fry, as soon as they left their nests, would seek the shallower terrace, where the adult bass were hardly ever known to venture, thus giving the young almost perfect immunity from their cannibalistically-inclined parents. When we commenced seining our No. 1 fingerlings, very few were found in any part of the pond except on this shoal or inshore terrace.

DISCUSSION

MR. W. O. BUCK, Neosho, Mo.: Dr. Bean mentions a change of temperature of ten degrees between the water of the lake in which the bass were reared and the temperature of the hatchery water. Now the increase of the parasites in the hatchery would seem to suggest that the hatchery water was the warmer. Was that the case?

DR. BEAN: No, the singular thing was that the hatchery water was colder. It is possible these fish were attacked in the ponds and the disease developed as soon as their vitality was reduced.

MR. L. L. DYCHE, Lawrence, Kans.: The appearance of these parasites would indicate that they were in the fish before they were transferred, would it not?

DR. BEAN: I think so.

MR. E. N. CARTER, St. Johnsbury, Vt.: In the past five years we have transferred bass from Lake Champlain to St. Johnsbury Station in the spring of the year and hatched eggs. We have had greater success in handling those fish than the fish that were held at the station. Some nests yielded as many as 20,000 fry.

MR. CLARK: Counted fish? Did you count the fry from the nest?

MR. CARTER: Yes, absolutely.

PRESIDENT: Large mouth or small mouth?

MR. CARTER: Small mouth. Up to last winter we were not able to carry any bass in the pond at St. Johnsbury, and so were obliged to transfer bass a distance of 100 miles, a ride of four hours on the train from Lake Champlain; and almost immediately the bass commenced building nests.

Dr. Bean speaks of the temperature of the water. We had more success in regulating the temperature of our pond by turning the supply off. The water warmed up in a day; we turned the pond supply off at night and carried our young bass successfully through the cold nights.

Mr. Dwight Lydell: With respect to that part of my paper that the gentleman read referring to the large-mouth black bass, I would say that the advanced fry were not secured from the station but came from auxiliary stations.

Mr. Buck: I do not know that the area of ponds is stated in the paper. It has been said that the small ponds mean results.

Mr. Lydell: It is stated in the paper as being 364 by 170 feet.

President: I think the entire pond area of the station is referred to.

Mr. Lydell: There have been built thirteen ponds up to the present time, with an area of four and a half to five acres.

Mr. Clark: I do not care to talk extensively on the bass. I want, however, to concur in almost everything that Mr. Lydell tells of in his paper—that is, whatever is new; there is no use of concurring in anything else because we have already done that. I refer particularly to holding the bass back. Put your bass in your pond today and they will spawn tomorrow, and we will guarantee it.

There is another thing that has not been touched upon that I would like to speak about, and that is relative to breeders. As some of you know, we have adopted the system at the government station at Northville of rearing our breeders. We have what is called a stock pond which was commenced three years ago. Fish of about three years are the oldest that we have transferred to the breeding pond. I think if the bass men would adopt this plan they would not only have no difficulty in getting breeders but they would get a better class of breeders. They are domestic fish; they do not frighten easily and you can rear them.

At any place you can breed bass you can rear your breeders. We have his stock pond, and last year we probably had about 600 or 700 yearlings, two year olds and three year olds. We took out of that pond enough breeders to restock what we lacked in our breeding ponds. Now you will find those fish, and especially the males, are better than the fish that you take from wild waters; and I think that the small females (of course, they are not large at three years old, where they are raised) will furnish more eggs for the weight of the fish than the wild fish.

I do not remember, Mr. President, hearing any of the bass men talk about raising the breeders. We have adopted that plan, and for two years we have not gone to wild waters for our breeders, which I think is the better policy. We took out of this pond (which was not designed as a breeding pond) last year probably 75 or 80 nice breeders. There is no spawning area that you would prepare, but around the edges there was a little gravel; and I presume there were anywhere from 30 to 50 nests after we took those fish out—showing you that we had not got all the breeders by any means. I would advise the bass men to try the plan of setting aside a pond for raising breeders, and see if they cannot get better results. You will get fish that are more domestic; they do not frighten easily; and I think you will get along with them nicely.

Another matter: Speaking about the number of fish to a nest, I want to mention just one case we had this year. We got by actual count out of one small-mouth bass nest 26,500 fry. It took two men all day long to count them. Dr. Evermann and our worthy President both saw the nest when the fish were almost ready to rise. They were counted a day or two after those gentlemen visited the pond. By some it has been thought that this is a good many fish for one nest, and I would have thought so myself if it had not happened at Northville. Occurring there it was all right. (Laughter.) But when you stop to think of 26,000 fry from one nest you may realize that it is about the maximum under normal conditions.

Now there is probably no question but that a bass in a great many cases where you have only 2000 to 5000 eggs has not spawned completely; she is driven away and spawns on another nest. In this case no doubt practically all of the eggs were deposited. Every condition was normal. Some have thought perhaps it was two bass that went on this nest, but if you will stop to think about pike-perch eggs you will remember that bass eggs are about the same size (150,000 to the quart). Now if you divide that down to about 30,000 you are not going to have so very many as regards bulk. I believe a five or six-pound female bass will contain anywhere from 30,000 to 50,000 eggs. That is my judgment.

Mr. Meehan: I want to concur with Mr. Clark, especially in the desirability of the bass men raising their fish. We started doing that three years ago as Mr. Clark did, and have reared fish to the age of three years. We find those fish are better; they seem to maintain better health and take food more readily and in every way act better than the wild fish that are introduced. I believe it to be the right policy.

Mr. Carter: That is not the experience at St. Johnsbury. Our wild bass are fine. We have some fish there that weigh four or five pounds that have been transferred from Lake Champlain, and they are not to be frightened at all. They are so tame, in fact, that the men feed them out of their hands; they catch live minnows, hold them by the head and the bass take them.

Mr. James Nevin, Madison, Wis.: We built a bass pond 750 by 400 feet. On the lower side the average depth is eight feet, gradually sloping to six inches. Much of the bottom of the pond is very stony, the stones running from six inches to a foot in diameter.

Last spring we put 140 fish in the pond and shipped out this year 200,000 fry. We drew the pond down the first of September and shipped out 60,000 bass running all the way from five to six inches long. The pond bottom was found literally covered with snail shells. I suppose you could pick up 100 bushels of the shells, but the bass had eaten all the snails. The fish were very fat, though we had not fed anything to fry or fish during the whole summer. These fish have been shipped out during the last couple of weeks. There is a sample in this bottle for those that want to see them.

Mr. Carter: I would like to ask about the depth of the ponds that Mr. Lydell and Mr. Clark have constructed.

Mr. Lydell: Between five and six feet in the deepest part.

Mr. Carter: We have not had success in carrying bass through the winter in ponds of that depth.

President: How deep are your winter ponds?

Mr. Carter: The pond we now have is about 10½ feet, greatest depth. Heretofore we have lost nearly all our bass during winter, but last year we put 103 adults in the deeper pond and took out 99 this spring, and I think it must be due to the fact that we have had a deeper pond. Our ponds freeze probably to a greater extent than they do in Michigan or some of the other states.

Mr. Clark: The pond that we use, which is known as a fish pond with us—where we hold our fish—is eight feet in the kettle, and, of course, slopes gradually up. We do not lose our fish during the winter. I do not think we lose 5 per cent—I do not think we lose, in fact, 3 per cent. They all come out in the spring nice and fat, but we put in quantities of minnows in that pond in the fall. I think the chances are if you did not have good results it is due to the food question.

Mr. Carter: Every spring we come out with 50 to 65 per cent of our bass dead.

Mr. Clark: There is something wrong then.

Mr. Carter: And we put in lots of minnows in the fall. We have ice from 24 to 30 inches thick.

Mr. L. L. Dyche, Lawrence, Kans.: Have you any indications as to what killed the bass?

Mr. Carter: No; we find them around the edge of the pond.

Mr. Dyche: Was there fungus on them?

Mr. Carter: Sometimes, and sometimes not.

President: The inflow in his pond may be different; or the character of the water may be different; you are in a somewhat different latitude.

Mr. Lydell: Our nesting ponds are 6 feet deep and our winter ponds 75 by 100 feet. Water is introduced by a pipe running below the surface of the water probably ten inches. This makes a good circulation and keeps the pond open four or five feet from the pipe the entire winter. I think that is one reason why we never lose any bass during the winter. Our fish are put in there in the latter part of September, or anywhere from then until it freezes up. There is a great quantity of minnows for them to feed on. This method aerates the water nicely and keeps the pond open.

I would like to make a remark about the transfer of bass. The last two seasons we have transferred bass from warm waters, but we always wait till just a few days before the spawning season. Our bass have spawned in our ponds before we go out to catch them in the wild waters. We have had excellent success in that way, but before that we used to go out early in the spring and get them from the fishermen at Saginaw Bay, or somewhere around there; and the conditions at the hatchery have more to do with it than the bass themselves. If the gentleman would adapt himself to his surroundings he would have better success.

The rearing of adult bass for breeders I think is possibly one of the problems we must figure out; we must have more room to do it in. We have at Mill Creek Station a wild stock pond and we dump in every summer all the large fingerlings. In the last two or three seasons when we seine them up in the spring we get 10 to 50 nice breeders large enough to put into our breeding ponds, and we in that way help to keep up our breeders. Still we have to go every year and get a few from outside waters.

Mr. W. H. Safford, Conneaut Lake, Penn.: Our small-mouth pond covers about 4½ acres. The temperature of the water is about 82 degrees. The depth is just a trifle under 4 feet. We have had no difficulty in carrying our bass over. We only lost two last year out of about a hundred. This spring they appeared to be in the finest condition possible, as fat and plump as could be. That pond produced this year 85,000 No. 1 fingerlings. We have a double system of overflow—an overflow for each pond. The water is about 3 feet 10½ inches deep.

Mr. Clark: The water in those ponds runs in temperature from 32.5 to 33 degrees through the winter.

Mr. Nevin: We had a large number of small-mouth bass which spawned the 21st of May, and there were about 30 nests. The eggs were 27 days in hatching from the time the fish were spawned on the nests. A very small percentage of fry was hatched from them.

Mr. Buck: Perhaps Mr. Lydell could help us if he would tell us what he does in the matter of collecting these young fish. As I have been obliged to run it we have to draw our ponds in order to get our young fish, and that results in the destruction of millions of insects and practically cutting off the supply of food for young fish for quite a time in that pond. I count on that being the end of the pond for that season. Is that the way you get at it or what do you do?

Mr. Lydell: We seine up all our number one fingerling and do not draw the pond down at all. Of course the advanced fry are taken from the fry retainers. They are not distributed from the pond at all. The number ones and twos are taken with a seine. The ponds are 75 feet long and six feet deep. About this time of the year we commence drawing down our ponds and taking out what are left. Previous to that the ponds are never drawn but the fish are taken by the seine.

Mr. Dyche: I have seven ponds from 2 to 10 acres each, and there is so much vegetation in my ponds that it would be impossible to put any kind of a seine in there. I cannot get any young fish out unless I send men in with pitchforks to remove the vegetable matter.

Mr. Meehan: Can't you keep a space clean six or eight feet from the shore?

Mr. Dyche: You cannot catch the fish there. All ponds are full of vegetation in my part of the country and cannot be seined.

Mr. Lydell: We have as much vegetation as anywhere, but before we seine the men rake out four or five feet from the shore. Then a larger rake is put in which takes it out about 20 feet from the shore. In many places we clear out a place for the seine over 60 feet long down the pond. The pond is covered with a line and the man simply draws the end along and drives the little fish ahead until they strike the clear water, and then we take the fish all up.

Mr. C. W. Willard, Westerly, R. I.: I have been much interested, from an angler's standpoint, in Dr. Bean's lack of success in taking black bass when the lake was in bloom. I would like to hear from some other angler or scientist on that point.

Mr. Meehan: We cannot get the bass under those circumstances and at that time unless we get where the wind has blown the bloom away; and there you can sometimes get them, but not freely then, because they seem to be sluggish or half sick.

Mr. Ward T. Bower, Washington, D. C.: The earlier part of Dr. Bean's remarks suggests to me that we are prone to pay too little attention to the food problem. I am referring to where he spoke of the great avidity with which the young bass took certain forms of larval life. The thought occurred to me that possibly here is one reason why Mr. Lydell is meeting with such remarkable success in his breeding of bass. He spoke of the enormous amount of Daphnia that may be found in his pond. He also spoke of the fact that the ponds that were drawn down, or partially drawn down, during the winter seemed most fertile in that food. I mention this because I think that oftentimes we go at the matter in rather a haphazard manner, trusting to luck. Possibly it would be well for us to look into the matter a little more carefully, for the output of fish certainly is gauged by the amount of food that the ponds produce.

Mr. Clark: There is one thing that I forgot while I was on my feet. You know we have talked a great deal about the chara moss and what a great food producer it is. I think at one time Dr. Evermann had much to say in regard to chara moss. Now we have this year met with rather poor results in rearing fish in some of our ponds, and I would like to ask Dr. Evermann if he thinks it would be possible for the growth of moss in one year in a pond to be so great that it would affect the food supply by smothering or some other process. I have an idea about it myself but I would like to ask him that question.

Dr. B. W. Evermann, Washington, D. C.: I really know nothing definitely regarding the matter, but all the experience that I have had leads me to believe that the quantity of food supply would necessarily be affected in even as brief a period as one year by the growth of chara or any similar species of aquatic plant.

As I look at it, chara would be most useful, or is most useful, because of its disposition to mat down and to furnish a nidus in which these small crustaceans and small protozoans and other small forms of animal life may thrive; and I can easily conceive that the matting down may be so dense as to overdo the thing; but ordinarily not.

Of course there are a great many different species of chara. I do not know which species you have most abundantly, but some will mat down more closely and compactly than others will. Some will stand up better and furnish a good nidus or breeding ground for the various species of small crustaceans. The greatest difficulty that I can see as to chara is the visible one that when it decays it becomes objectionable in various ways. But as Mr. Lydell said in the beginning of his paper, I think the chara proposition must be worked out at each individual and particular place. I do not think that in the lakes I know about in the Mississippi Valley it is particularly objectionable. It is very desirable in forming a nidus for the growth of small crustaceans on which young fish can feed, and particularly desirable as furnishing a safe retreat for young fishes from the older ones, if you keep your breeders and small fish in the same pond. But it does not furnish food to the fish themselves, as some potamogetons do, and like other species that are actually food in themselves.

Mr. Clark: In our eight or nine ponds this year the best percentage of fingerlings came from the pond where we had the least chara, but, in my judgment, it had plenty. The pond where it was the most matted gave us the smallest percentage of fingerling fish. I was going to try an experiment by raking one pond and not allowing chara to grow in it to see what that would do. We got more fish from the pond where there was the least growth of chara this year.

Mr. Nevin: Why not freeze the pond this winter?

Mr. Clark: We have chara moss in great abundance in a new pond we built last year. The water was turned in this spring and the chara moss was right in the soil and grew to such extent this year that before we hauled it to get our fingerlings out it was a solid mass through the water. The pond was hauled the 1st of July and the fish taken out; and I wish you could see it now. It is covered with piles of this chara moss that we have raked up.

Mr. Lydell: After chara moss decays in the ponds it seems to have a limy appearance when dry. We let the chara mat down and freeze before turning the water on. You can take great handfuls and rub it and it seems to be full of lime. From that particular pond we did not get near the food that we did in the pond where we removed the substance entirely. In regard to the food supply the idea of freezing the ponds came to us one season when some work was carried on; and the amount of food we had next season in the pond was noticeable. Professor Reighard was there and I was telling him about it and he said that the reason we had it was because we drew it down and let it freeze. Why do we have plenty of food in the ponds we freeze and not so much in the ponds that we do not freeze? It seems to be there and that is all I can tell you about it.

OBSERVATIONS CONCERNING THE NATURAL FOOD OF SMALL-MOUTH BLACK BASS FRY AT MAMMOTH SPRING, ARK.

By Stephen G. Worth

It is only for the good that may follow and from no disposition to vaunt myself that this paper is written. I have been connected with small-mouth black bass operations but eight months, and thus am but a beginner. Below I set forth briefly a few observations that are to the point, I trust.

(1) Apparently the rooted or fixed aquatic plants—Myriophyllum, etc.—abounding in the ponds of the Mammoth Spring fish-cultural establishment do not contribute except indirectly to the production of the minute crustacean life which constitutes the food of black bass in ages from fry to No. 1½ fingerlings, as it has been observed that fry in rearing ponds yield better results when the ponds are previously drawn, the vegetation being removed by rake and pitchfork and the pond bottom exposed to air and sunshine effects some days before reflooding and the introduction of the fry.

(2) No solution of the source of the crustacean diet was arrived at except through the book of Dr. Hugh M. Smith entitled "Japanese Goldfish."

(3) I am satisfied, since reading Dr. Smith's chapter on goldfish food and feeding, that free moving, microscopic plants, known to naturalists as algæ, comprise the food of said crustaceans, and that pond bottoms exposed through the winter months produce more crustaceans than ponds (fed from spring at temperature of 59° F.) that are kept full of water through the cold months with the "water moss" growth undisturbed.

(4) Ponds producing most "bugs," or Daphnia, terms

employed at Mammoth Spring, or "mijinko," as collectively called in Dr. Smith's book, were those of rank plant growth that were dry all winter or else those with practically new clay bottom that were dry all winter.

(5) Very slow change of water in ponds is conducive to the production of "mijinko,"—as the Mammoth Spring lake, and Spring River resulting from the spring and lake, and Warm Fork, a stream 40 miles long, all contiguous to the station, contain no "mijinko" in quantity, these waters, in fact, being practically barren of the "mijinko" forms, while the ponds of the station are marvellously stocked with them.

(6) Earth embankments and other surrounding lands that are rich in nitrogen-producing substances contribute to "mijinko" production. The enormous numbers of "mijinko" in the station ponds are, in part, doubtless, due to the presence in recent years of pens of stock—cattle, hogs, and poultry—that were sent away in carload lots from Mammoth Spring railroad station.

(7) "Mijinko" are not found in the rank "water moss" vegetation at Mammoth Spring but in open, deep water near the outlets of ponds and massed in greatest profusion above bare areas of bottom where no plants grow.

(8) Greatest numbers of "mijinko" were observed when the water temperature dropped, in April, to 40° F. The "mijinko" do not disappear when the water temperature goes up to 80° (June).

(9) "Mijinko" assemble themselves around objects in the water, such objects as artificial nest shields, stakes, etc., and especially massive outlet gates or "standpipes."

(10) It is better to rear black bass fry in ponds where they can capture their own food than in cement or other tanks where the food has to be supplied to the fish from day to day for the reasons that (*a*) capturing "mijinko" is a slow and expensive operation, (*b*) the fish from ponds are more numerous at shipping time than are those reared in tanks, and (*c*) the fish grow relatively faster and larger in ponds.

(11) The natural enemies to bass fry in Mammoth Spring ponds are two fishes that enter from Mammoth Spring lake, the "grass pike" and "codfish," which, I believe, are the genera *Esox* and *Cottus,* respectively, or common pickerel and miller's thumb. It is difficult to exclude these enemies but not impossible when intake wire mesh that is 16 meshes to the inch is imbedded in a concrete base.

(12) The Japanese methods of producing "mijinko" must be studied if American black bass rearing is to be carried on largely and successfully.

THE SUNFISH

By John L. Leary

Slowly upward, wavering, gleaming,
Rose the Ugudwash, the sunfish,
Seized the line of Hiawatha,
Swung with all his weight upon it.
* * * * * * *
But when Hiawatha saw him
Slowly rising through the water,
Lifting up his disk refulgent,
Loud he shouted in derision
Esa! esa! shame upon you!
You are Ugudwash, the sunfish,
You are not the fish I wanted,
You are not the King of Fishes.

—*Longfellow.*

Hiawatha was wrong in his estimate of the courage of the sunfish, for taking size into consideration it is a gamy, tenacious, and vigorous fighter, and, in my estimation, the gamest of all our fresh-water fishes, as every boy will assert and the older sportsmen certify to. In looking backward through the long vista of years, I can recall the fishing of my boyhood days in the lakes and ponds of eastern North Carolina; especially do I remember a chain of ponds on the sand dunes of Nags Head, laying between Roanoke Sound and the Atlantic Ocean. These ponds teemed with this gamy little fish, and as memory carries me back to the youthful sport of bathing and catching sunnies, it makes a page in a man's history pleasant to dream over, a period of life never to be forgot.

I feel that the propagation of this beautiful and economic little fish has been very much neglected. This in part, no doubt, has been due to the fact of its great fecundity, for it is one of the most prolific as well as most widely distributed of all our fresh-water fishes. It is one of the basses, not quite as aristocratic as some of its big kinsmen, yet the little yellow bellies are known in many localities as sun bass; and this is the fish that nearly every boy has fished for with his home-made tackle, a strand of black cotton, a bent pin, and the red angle worm for bait. The sport of catching these little fellows has not only afforded delight and pleasure to the young fisherman, but the old and sporty angler becomes fascinated in hooking this gamy little fish.

Aside from the sport of angling for the sunfish, I wish you to know that it is a toothsome morsel, and no better or firmer flesh is found in ocean, river or lake. And right here I will give you a recipe for cooking the little fellow. Provide a deep round or square pan as large or small as you please, have fitted into this pan a basket made of half-inch mesh wire netting, fill your pan half full of good lard, have the fish prepared as usual, then roll them in corn meal seasoned with pepper and salt, fill the basket with fish and immerse them in the boiling lard. In a few minutes they will be a beautiful brown, and served with potato chips, bread and butter, olives, and coffee, they are fit for the table of a king.

Now about the propagation of this fish, and the best kinds to propagate. First your pond should not be of a size less than one-half acre and several acres would be better. Then there should be a good supply of water either from spring, spring branch, or rain, any of which will give good results if you have an abundance of it. In constructing ponds you can conform to the lay of the land; but care should be taken to have plenty of shallow water, sand, clay, gravel, or mud bottom will do so long as the pond holds water. Shade in abundance around the pond with plenty of water plants makes an ideal condition for the sunfish.

These little fellows, like the black bass, are nest builders, sweeping and scooping out a nest in shallow water about the size of an ordinary wash basin, each pair keeping house to itself although living in communities. I have seen half a dozen nests in the space of 20 feet square. The fish take several weeks in nest building, and when all is ready they deposit their eggs, and in from five to eight days, depending on temperature, they have their little families. The young fish go in schools for only a short time, and, owing to this fact, the young are much preyed upon by other fish, still they are so prolific that this loss is hardly apparent.

The best species to propagate are the copper-nose bream or bluegill (*Lepomis pallidus*) and the green sun perch (*Apomotis cyanellus*), these being the largest of the sunfish family. They take the hook readily, and the red angle-worm, flesh from the tail of the crawfish, and the common river shrimp make fine bait.

Dr. G. Brown Goode says of the sunfish in his "American Fishes": "I prophesy that they will yet be introduced in all the suitable waters throughout this continent which they do not now inhabit." From a small pond you will realize much pleasure for self and family, and from an economic stand-point, the pond will prove a veritable boon, providing at all times a most palatable food, costing only the pleasure of successful angling, driving away dull care, making you feel friendly with all mankind. I ask you, What more could this little fish do?

RESCUE WORK—THE SAVING OF FISH FROM OVERFLOWED LANDS

By S. P. Bartlett

Some time in the early seventies, Mr. B. F. Shaw, an ardent and able fish culturist, was appointed fish commissioner of Iowa. He made a careful study of the conditions existing in his State to ascertain the causes of the rapid decrease in the coarser varieties of fish, and to prevent further loss, if possible, as well as to increase the supply. He found, first, that the buffalo, then the principal market fish, were being taken in large numbers at every spawning season from the shallow ponds made by the overflow of the rivers, where they went to deposit their spawn. Of those allowed to spawn a large proportion perished when they were left in the overflows by the receding water, and, with the coming of hot weather and the consequent rapid evaporation, the fry so left either died with the drying up of the ponds or were frozen out in winter, if not devoured previously by birds or mammals when the water became shallow.

Practically without funds, Mr. Shaw made a personal examination of the sloughs and ponds along the Mississippi River in his State, and concluded that, as he could not attempt artificial propagation, he would utilize the natural supply that was then going to waste by seining out these flat ponds and selecting such material as could be safely moved, putting the better varieties into the inland waters and depositing the residue in the river or nearest deep water.

These attempts were largely experimental, as the means available only permitted the use of a small tug with a limited crew for a short time, but Mr. Shaw had confidence in his theory, and at a meeting in Chicago of men interested in fish culture, in 1877 I think, he told of his experiments to those assembled. He received only perfunctory attention, however, as the then all-absorbing interest was in artificial propagation.

At that time I was new to the work and, like Mr. Shaw, I was deeply interested in the betterment of conditions in my own State, Illinois. Through the courtesy of Mr. Shaw I was given all the information on his methods that his experience had given him, and after making him a visit and seeing an exemplification of his work, I took it up and made it the basis of operations in the work of the Illinois Fish Commission. Since that time, in fact, following closely upon it, the United States Commission of Fisheries has pursued the same line of work, and with cars fitted specially for the transportation of the fish so saved, has made it one of the most profitable of its methods of increasing the fish supply.

The State of Illinois probably presents as good a field for this work as does any in the country. The Mississippi River for four hundred miles on the west, the Ohio River on the south, the Wabash River on the east, and the Illinois River running directly through the State for two hundred and fifty miles, and the borders of all these streams closely cut by lakes and sloughs, mostly flat and filled by the overflow from the rivers, supply all the conditions required for the work. Into these shallow waters come all the indigenous varieties of fish to find spawning beds, and when conditions are favorable they complete their spawning before the water recedes. The falling of the water leaves the deeper places well filled, but later evaporation and seepage cause most of them to dry out; such as retain 18 to 20 inches of water until winter sets in freeze to the bottom, and in any case the life that they contain perishes. Seasons vary, conditions changing with them, and occasionally there is a year when high water continues and the fish go through the season without damage; and as if to emphasize the practical value of the work, the season following always shows a greatly increased number of our native fish, particularly the black bass.

It is remarkable what a high temperature these stranded fish can endure, and how tenacious of life they are under desperate conditions. I have seen, many times, a mass of fish almost out of water in these holes, struggling for life in the mud, and with the bottom of the pond baked hard to within a few feet of the depression to which they had been driven as the water dried down. The falling water is not the only menace to the life of these fish, however, for bird and beast prey upon them in these shallow places, so easy of access, fish, fry and spawn being all subject to their depredations. Along the Illinois River the pelicans, because of their number, are perhaps their worst bird enemies. If the water does not dry out and leave the fish to die, their destruction is assured as soon as the pelicans arrive on the scene. I have seen a lake of perhaps a mile in extent completely cleaned of fish by a flock of pelicans. Marching through the shallow water in as perfect alignment as a body of soldiers, and beating the water with their wings, these birds drive the fish before them until they have them surrounded and quickly gobble them into their capacious pouches. It has happened more than once that our crew would visit a lake, perhaps make a trial haul and find it full of fish; then, after waiting a few days for the water to decline until it was drawn away from the buck brush that surrounded it, so that it could be worked, they would find, on their return, that not a fish remained. The tracks on the shores showed plainly what had become of them.

The field of work is so large and the difficulties encountered are so many that only a small portion can be covered with the means and appliances at our command. Many of the places are so remote from the river and the transportation of the fish from them to the deep water is attended with so much risk and expense, that up to the present time but little success has been had in many of such places. Then the muddy conditions of these ponds and their surroundings not only doubles the work of seining, but also adds to the mortality of the fish, for when they are taken from the muddy water and placed in the vessels for transporting, they quickly die in transit. Last season, on a trip of one hundred and fifty miles on the Missouri side of the Mississippi River, I saw enough fish in the adjoining flats that were dying or would die, to supply the whole State if they could have been rescued and distributed. This would have been impracticable for the greater part, but it illustrates the possibilities where the conditions and location of deep water are favorable. Nearly all of these ponds are well filled with spawn if the water remains high until after the spawning season is over; and bass, crappie, bream, catfish, ring or yellow perch, white perch, carp, buffalo, hickory shad, minnows, etc., are all found, and for the last two seasons wall-eyed pike (pike perch) were seen. The coarser varieties constitute about eighty-five per cent of the whole, and of these the shad usually predominate, great quantities of them being found in most of such places. They are not hardy enough to stand being moved at all, unless it happens that the ponds are so near deep water that the contents of the seine can be emptied bodily without trying to separate the varieties for distribution.

One of the practical phases of the rescue work is the saving of coarse fish that are just under the legal size for market purposes. During the open season, when seining is lawful, all fish of such size are not taken by the fishermen, and many are thrown back into the ponds to die unless they are rescued in time, in which case they have the benefit of another season's growth and add materially in the natural increase in the supply.

Locally, the rescue work is of vital importance, and it seems that it would be of great economic value if the states or the national government would assume control and overcome existing conditions, pursuing this work to such an extent as to preserve these fish wherever found.

Another factor in this question that will make some such step an imperative necessity, sooner or later, is the fact that each succeeding year finds the area of breeding grounds materially lessened as the levee districts increase in number and extent. The ditches drain off the water from thousands of acres of land, and it is only a question of time until all the fish furnished by nature will be needed to stock the lakes and rivers. It is natural to presume that such large and fertile tracts of land will not remain subject to overflow, and with each new levee district the number of natural breeding grounds is lessened. The situation presents possibilities to which I should like to call attention, for while the levees are draining the lands for practical farming purposes, many of the lakes inside these districts are not drained and do not go dry in any weather, and it seems as if it would be a movement of practical economy for the state or government to control such waters and utilize them for pond culture. There will always be thousands of acres of water on the islands and along the water courses that could not be protected by levees, on account of the expense necessary to success, and these too could be utilized for breeding grounds.

Years ago, when the country was new, but little importance was given to the conservation of natural resources, and the prodigal waste occasioned by the taking of fish during the spawning season almost depleted the waters. This has been checked to a great extent by fair protective laws, and now the demand for the utilization of all waste lands for cultivation must be met and many of the natural breeding grounds will be destroyed. It may be far in the future, but it is sure to come, and proper precautions should be taken to protect and preserve the natural increase of our food fishes before that day arrives.

As an example of what is being done in Illinois in the work of rescuing the fish, I will cite one catch made on August 14, 1910. A crew of men working for the United States Bureau of Fisheries took out of a flat pond near the Lagrange Locks, on Illinois River, 150 adult black bass, 3,000 adult crappie, 3,000 adult bream, 750 adult carp, 750 adult buffalo, 5,000 adult catfish, and, in addition, a large quantity of small fishes, 6 inches in length, such as shad.

minnows, etc. The water was hot, and if the distance from the pond to the river had not been short, the work could not have been done successfully. Estimating the bass at one-half pound each, the bream and crappie at one-quarter pound each, the catfish at ten to the pound, and the carp and buffalo at one pound each, there were rescued and transferred to the river a total of several thousand pounds of fish, which with another season's growth and their natural increase will have added materially to the supply. On August 18th, 120,000 small catfish were taken from flats in the same locality and transferred to the rivers.

The possibilities of the work are great, but they can be developed only with equipment specially designed for the work, and at present only where the distance to be covered in transit is not too great. Some method will have to be devised to overcome the difficulties presented before the field can be fully covered. But I believe the time will come when the work will be taken up in all the states, where similar conditions exist, to conserve the natural resources of the waters for the benefit of the people.

UTILIZATION OF SEA-MUSSELS FOR FOOD

By Irving A. Field

During the past five summers the United States Bureau of Fisheries has been conducting experiments at the Woods Hole, Mass., laboratory to determine the food value of certain hitherto unutilized marine products. The purpose of the investigation is to place cheap, wholesome food within reach of the masses and to increase the business of the fisherman and packer. The importance of such a study is obvious at this time when everyone is beginning to feel the pinch of high prices and scarcity of food.

Effort has been made to find forms that are palatable, digestible, nutritious and at the same time very abundant and readily obtained. A species which conforms with these requirements is the sea-mussel, *Mytilus edulis,* and it is to this neglected shellfish that I wish to call your attention. True, it is not an utterly disregarded food product, but its palatability and high nutritive value are known to so few individuals, especially Americans, and it is so abundant, widely distributed and easily procured that I feel the importance of making known its qualities.

The mussel is clam-like in appearance with a much pointed umbo or beak situated at the anterior end of the valves. It varies from 2 to 4.5 inches in length and from 1 to 1.5 inches in diameter. The color of the shell proper varies from violet to a pale blue. Externally it is covered with a horny epidermis of shining blue-black. This species is distinguished from the horse mussel, *Modiola modiola,* which it most closely resembles by the position of the umbo and color of the epidermis. The umbo of the horse mussel is located a short distance back from the tip of the shell and the epidermis is brown instead of blue.

Reproduction occurs at different times of the year according to the locality and temperature of the water. In Long

Island Sound, for example, spawning takes place during the months of April, May and June and a few individuals may spawn as late as July and August. In the Atlantic Ocean off Coney Island and Sandy Hook where the water is cold they do not spawn out much before September. The eggs flow from the female in a steady stream, sometimes in the form of a string which breaks up into short segments or occasionally as a lot of separate eggs. In quiet water they sink to the bottom, forming a pinkish mass. About 13,000,000 eggs are deposited by a female each season. The male discharges clouds of milt into the water; it mixes with the eggs which, when impregnated, develop at a rapid rate. Free-swimming embryos are formed within four or five hours after the genital products meet. The embryos are borne hither and thither by the tidal currents for from three to five days. By this time they have formed a shell and begin to attach themselves to sea weeds, hydroids, wharf piles or other convenient objects. A foot is then developed which becomes the chief object of locomotion and by means of it they creep from unfavorable situations to more suitable ones.

Growth, under proper conditions, is rapid. When planted at the mouth of an estuary where food is supplied in great abundance, where there is no deposition of silt and where there is little or no exposure between tides, they reach a length of three inches in from two to three years. Four years in such a situation will produce the finest of mussels measuring close to four inches in length.

The distribution of the sea-mussel is very wide. It is found from the Arctic regions south on our Atlantic Coast to North Carolina, on the Pacific Coast to San Francisco, on the Asiatic Coast to Japan and on the European Coast as far south as the Mediterranean Sea. It is exceedingly abundant in the shallow, sheltered bays along the coasts of New Jersey, Long Island, Rhode Island and Massachussetts.

The bathymetrical range is from the littoral zone to about one hundred fathoms. The majority of beds, however, are most commonly found from between tide limits to seven fathoms of water.

Although exceedingly abundant, sea-mussels have been utilized as food to a very little extent in this country. New York constitutes the chief market for them but it is very limited. A few mussels are sold in Boston, Providence and Philadelphia. The market is small because the people are not familiar with them. As soon as the public can be taught that this shellfish is a superior article of food, the demand for them will increase greatly. For centuries they have been esteemed as a delicacy in France where they are eaten in great quantities. In 1905 the mussels cultivated on the French Coast amounted to 425,492 bushels valued at $222,439. A prominent hotel chef has been quoted as saying: "If mussels were not so plentiful and cheap in America we would probably anxiously wait for their coming on the foreign steamers that bring us the queer foods at exorbitant prices which are not to be compared with those of our own country." This is a very truthful statement concerning our human natures; we do not appreciate the value of a thing until it is rare or beyond our reach.

A measure of the food value shows that the sea-mussel constitutes a large portion of our fisheries wealth. To determine the palatability I have depended upon the testimony of numerous persons who ate them in their homes or at a large boarding house in Woods Hole, Mass. The mollusk was served in various styles, such as steamed, roasted, fried and pickled. The testimony was almost unanimous that in flavor and texture it is superior to the soft-shelled clam and every bit equal to the oyster.

The flesh has been found to be very digestible. Careful experiments made by Dr. D. D. Van Slyke, of the Rockefeller Institute, Dr. W. B. Clark, of the United States Department of Agriculture, and C. B. Bennett, of Brown University, on the rate of digestion of steamed beef and steamed mussels in a dog, show that the rate for each is about the same. It was deemed best to use a dog in this case because a man would not tolerate for a long time the simple diet required and because it is very probable that the foods would rank in the same order although, of course, the results are of less practical value. By the method of artificial digestion conducted by Dr. Carl S. Alsberg, of the United States Department of Agriculture, it was found that mussel flesh digests at about the same rate as hard boiled eggs and somewhat more slowly than steamed beef. The two experiments on digestibility, therefore, are in harmony and speak well for this quality of the shellfish. Experiments with men indicate that the cooked mussel agrees well with the human stomach and constitutes a good food for invalids. Persons who cannot eat meat without suffering discomfort have found that this mollusk can be digested with ease.

The nutritive value of mussels measures up very well with that of other shellfish. If we compare the ratio of edible parts to refuse in the mussel, clam and oyster we find that the edible portion of the mussel is approximately 53 per cent, of the clam 56 per cent, while that of the oyster is but 17 per cent. Chemical analyses made by Alsberg, Clark, Atwater and Bryant on mussels, clams, oysters and beef give the following results:

COMPARATIVE COMPOSITION AND FUEL

Items	Water	Protein	Fat	Carbohydrate	Ash	Fuel Value Per Pound
	Pct.	Pct.	Pct.	Pct.	Pct.	Calories
Mussels	83.27	10.18	1.64	1.74	1.99	290
Long Clams . . .	84.5	9.0	1.3	2.9	2.3	275
Oysters	86.9	6.2	1.2	3.7	2.	235
Lean Beef	55.3	16.7	11.2	....	.8	785

It is obvious from these determinations that in chemical composition and nutritive value the mussel is far superior to the oyster, is about equal to the long clam, and has about one-third the value of lean beef. To make the comparison in other terms we may say that 5.5 pounds of mussels in the shell or 2.75 pounds of the meats and liquor in their natural proportion are equal in food value to one pound of lean beef.

In addition to being palatable, digestible and nutritious the mussel is an abundant, inexpensive food. In the bays and estuaries of our north Atlantic Coast they grow in great beds, often acres in extent, reaching from between tide marks out into several fathoms of water. A fisherman in Oyster Bay, L. I., told me that he shipped 100 barrels of mussels a day to New York during the past February and March, making a net profit of 75 cents per barrel. If there was a demand for ten times that quantity the Oyster Bay locality alone could supply it and there are a hundred other places in Long Island Sound that are just as productive. All but a very small percentage of these beds are being ignored and wasted.

There is one objection which has been advanced against eating mussels. They spoil quickly when removed from the water and develop ptomaines which cause serious digestive disorders producing a swelling of the head and abdomen with red spots on the skin known as "mussel rash." Mr. C. H. Walters, of the New York State Fish Commission, has informed me that a patient afflicted thus may obtain prompt relief by drinking a pint of strong, black coffee. Such cases of poisoning need not prejudice one against this food, however, for similar effects resulting from the eating of oysters, clams and lobsters are much more common. If the same precautions are taken in marketing mussels that are taken with other shellfish they will be found perfectly harmless. Most of the trouble which has resulted so far has been from unscrupulous dealers who have palmed off on their customers barrels of decayed mussels covered on top with a few fresh ones. To those who wish to develop the trade I cannot emphasize too strongly the importance of selling strictly fresh, living mussels. They should be taken from deep water and by all means marketed or properly preserved on the day they are collected.

Fortunately the mussels are well adapted for preservation in such a manner as not to impair their palatable flavor, nutritive qualities and digestibility, and at the same time not greatly increase the price at which they may be sold to the consumer. This is a property which ranks them superior to all other shellfish. At the present time they are preserved by one method only, that of pickling with vinegar and spices. Pickled mussels may now be found on the lunch counters of saloons in New York City or purchased in bottled form in the downtown delicatessen stores. Prepared in this manner they are quite palatable, but to get their full, rich flavor they should be canned.

Preservation by canning is a method which, to my knowledge, has never been employed for the mussel in a commercial way. Experiments with this process have demonstrated that the mussel with its liquor can be preserved without loss of color or flavor and the canned product may be prepared for the table in a great variety of ways. In fact it can be used in almost as many ways as the fresh mollusk. The details of this method will soon be published in a document of the United States Bureau of Fisheries. It may be well to state here that three principles have to be observed in this process: (1) the mussels must be fresh and fat, (2) they must be packed in glass containers, (3) they must be sterilized at not less than 220° F. for one-half hour.

I cannot recommend too highly the excellent quality of the canned mussels. They may be used to make a delicious soup or chowder, an excellent fry, savory fritters, cream sauces and numerous other appetizing preparations. If once used in a household they will ever remain in demand. They make a good substitute for the oyster when it is out of season. Packers of shellfish will find employment for their hands in this industry when the oyster season is over, March to August being the months when mussels are prime. In this vicinity, Long Island Sound can furnish the winter and early spring supply while the Atlantic Ocean can provide for the summer trade.

New York City, I believe, has the honor for developing the first market for fresh and pickled mussels in this country. A very limited call for fresh mussels is beginning to be heard at several points along the coast. All that is lacking to start a market of national proportions is a packer enterprising enough to put a few canned samples in the hands of retail merchants and of proprietors of hotels and restaurants. The product will speak for itself and its fame as a delicious food is bound to spread rapidly. There is an opportunity here which the packer cannot afford to overlook. It is extravagance and waste to allow this vast supply of food to go unutilized.

DISCUSSION

PRESIDENT: That is a very able paper both from a scientific and a practical standpoint.

MR. L. L. DYCHE, Lawrence, Kans.: Is there the same species on the Atlantic and Pacific Coasts?

PROFESSOR FIELD: Yes, sir.

MR. DYCHE: I have found enormous quantities of them on our own coast from Labrador north to Cape Sabin, enormous quantities of them also on the Greenland Coast and on the west coast. They constitute the sole food of the walrus. The walrus crushes and spits out the shell and swallows the mussel. I have killed 24 to 30 walruses and have found in the stomach on occasions a ball containing two quarts of pieces of shell and other material from the sea mussels. Whales eat squid, and seals eat squid and small fish, but the only thing that the walrus feeds on in the north is the sea mussel. The eider ducks eat the small ones, about an inch in length, and you will find the ducks oftentimes full of these mussels clear to the throat; I do not believe I would be exaggerating if I should say there was a pint in each. Turkeys killed in the Oklahoma country have been found full to the throat of acorns, and the eider duck will be full to the throat of small mussels.

MR. W. H. BOARDMAN, Central Falls, R. I.: For the last thirty years mussels have been considered quite a choice article of food in Rhode Island, and, I think, are held superior to other shellfish. They are especially preferred by the English. For the last 35 years there has been a market for them. In Rhode Island waters the oyster men get rid of them in the easiest manner possible, but the market is growing constantly. They are a nice shellfish if you know how to prepare them.

MR. WILLIAM A. BRYAN, Honolulu: Our coral reefs about the Hawaiian Islands are paved with these mussels, and curious things they are. While the Hawaiians are frequently hard up to get sufficient animal food, I have never known of their making use of these shellfish. This is rather curious when they pick many smaller mollusks from the rocks and esteem them. It looks as though for some peculiar and unknown reason they have never taken to these mussels.

Mr. W. O. Buck, Neosho, Mo.: It is traditional on the east coast, passing down from the Indians, that mussels are poisonous, and they have not been used for that reason. As Professor Field spoke of their being poisonous under certain circumstances, it occurred to me to ask if it is possible that there is a poisonous variety, or a season in which mussels are poisonous? I suggest this to get at the origin of that tradition.

Professor Field: There is possibly a species of mussel that is poisonous; but, as I have mentioned, if the mussels are not fresh they give rise to serious digestive disorders, and one or two cases have resulted in death. For instance, a great many years ago when Alaska was under Russian control and Bernhoff was governor, there was a party of 200 Aleuts who were collecting furs for him and camping on the shore of Bering Straits. They saw mussels exposed above low-tide mark, collected large quantities and ate them, and 150 of the 200 died before morning. The explanation was that these mussels were exposed for a long time in the sunshine and had decayed. The liquor in the mussel decays readily, and it was really a case of ptomaine poisoning. You must be sure that a mussel is alive before cooking it. It is like a lobster. Be sure your lobster is alive before you put it in the pot.

Mr. E. N. Carter, St. Johnsbury, Vermont: I have seen certain Indians gathering mussels in great piles, wading out in the water, getting and shelling them. The Indian women gather around the beds in the river and scoop up the mussels, take them to shallow places, and shell and eat them.

Mr. Boardman: In connection with the mussel's spoiling, exposing them to the sun is the way the oyster men have of killing them when they are so thick on the oyster beds that they will smother the oysters. It kills the mussels, not the oysters.

Mr. Dyche: I would like to ask as to the difficulty of gathering and preparing these mussels.

Professor Field: It is much easier to collect mussels than oysters. In fact you can go out with a pitchfork and load them in the boat. The difficulty comes in assorting them. As taken from the water they are covered with mud and all hang together. In dredging you can probably pick up greater quantities than of oysters at one set of the dredge. I know of one case where the steamer *Fish Hawk,* dredging in Vineyard Sound, took up one ton at one set.

Mr. Dyche: How about the difficulty as compared with clams?

Professor Field: It is much easier. You get clams one by one and mussels you get by the pitchforkfull. You could load mussels into a freight car as you would sand, if you could get the car to the proper point.

Mr. Ward T. Bower: Professor Field's remark in regard to the loss of life as a result of eating mussels reminds me that in Alaska this summer I talked with a number of people on the subject of mussels and in almost every instance they stated that they were afraid of them. There seems to be a fear of eating mussels because of numerous instances of loss of life. Possibly they have in mind mussels which are in the regions where there are copper deposits, and they steer clear of those sections; but I was wondering if there were any means whereby you could definitely tell whether the mussels were edible or not.

Professor Field: Dr. Dall informs me that mussels taken from deep water will not poison anyone; only the ones that are exposed to the sun between tides are dangerous.

Mr. Bower: Then if they dig mussels at extreme low tide there is no danger.

Professor Field: No, or if you dredge for them.

Mr. Lydell: I do not know a great deal about mussels, but last summer there was a party of us out camping, and when we ran short of meat we went out into the lake and got a lot of freshwater mussels. Of course, if we had known then what I have heard here we probably would not have eaten them for fear of poison. We gathered up half a bushel, took them to camp, and had them roasted. They were good and enjoyed by everybody. We all partook of them, ate all we wanted, and it did not hurt any of us. We thought they were very fine. The saltwater mussel should be better than a freshwater mussel.

Mr. M. C. Marsh, Washington, D. C.: I have eaten these mussels both canned and pickled. I very much prefer the canned to the pickled. But among the several people who used them that I refer to, some thought the pickled were better.

President: In view of the palatable and nutritious qualities of these mussels it seems very strange indeed that they have not taken higher rank as a commercial food product, and especially as food prices have more than doubled in the last ten years. I would like to ask the doctor how he would explain that. It seems to me there is a splendid opportunity to develop what we might call the mussel fisheries.

Professor Field: The brief reference I made to it in my paper was that there has been a natural prejudice against the mussel from the very first. One of the speakers mentioned the Indians as having a prejudice against it, no one knowing why, and that prevented the white settlers from eating them. The white settlers took to eating the long clam, which is common in Europe but only used for bait.

I think the reason why mussels have not been used more for food is that they are so abundant and spoil so quickly.

The point which I would emphasize here is that they can be preserved now so as not to injure in any way their palatable and nutritive qualities. It is possible to put them up in glass and at the same time not greatly increase the price, so that the consumer can buy them cheap. I am sure if they were put on the market and once tried, the demand would grow. Everyone I know who has used them in any way at all at home has asked for more, and wished to buy them on the market; and the reputation of the mussel has gone half way across the continent. If the packers would only put them on the market packed in glass, I would guarantee that they would find a sale.

Mr. Dyche: I found a prejudice against them on the Pacific Coast and on the Labrador Coast, and as far north as there are any fishermen they are prejudiced against them. I have eaten them myself and like them. Along the Greenland Coast I do not remember seeing any shells around any Eskimo camp. The Eskimos nearly starve to death sometimes but I never knew an Eskimo to eat a mussel. The fishermen are afraid of them; they make them sick, they say.

Professor Field: I have been eating them for four years and I am still alive.

Mr. Dyche: I have eaten them several years and I am still alive.

Dr. Briggs: They make a good bait and it may save some of our clams if we can take a can of mussels for bait instead of clams.

Dr. Raymond Osburn, New York: I am one of Professor Field's original victims at Wood's Hole, and have not suffered anything in stature at least. If any of us visited the Mediterranean region and saw how they utilized this species of shellfish it would open our eyes to the possibilities of this source of food. When you find them diving for mussels and see naked boys around Naples bringing up specimens no larger than my thumb and marketing them it gives us an idea of the way in which those people appreciate and are utilizing sea mussels as food.

Mr. W. E. Meehan, Harrisburg, Pa.: Are the mussels the professor speaks of the same as the blue mussel?

Mr. Dyche: The Danes can them and eat them, but that is a different shell fish. I never saw the Danes eat the blue mussel. It is a different species altogether.

Mr. Donald Nicoll, New York: I spent considerable time in my younger days in Australia, in Melbourne and Sydney. There they considered mussels quite a treat. I never heard of their being poisonous until I came to this country. But I have heard that they have a little beard or byssus which is poisonous.

Professor Field: That is only a superstition.

Mr. Nicoll: They eat them a great deal in Australia. They consider them a great luxury and never complain of any ill effects.

THE MAGNITUDE AND SCOPE OF THE FISH-CULTURAL WORK OF THE U. S. BUREAU OF FISHERIES, 1910

By R. S. Johnson

Fish-cultural operations were conducted at 35 permanent stations, in connection with which field collecting stations to the extent of 86 were operated, the work of the Bureau extending into 32 states. Forty-two different species of fresh and salt-water fishes were propagated at the various stations, and large collections were made from the overflow waters of the Illinois and Mississippi Rivers of fishes indigenous to that region.

The total output of fish and eggs for the year amounted to 3,231,462,579, exceeding the record year of 1909 by 124,330,668.

Four hundred and forty-three million one hundred and seventy-seven thousand eggs and 18,250 fishes were delivered to various state commissions, and 600,000 eggs of the salmon and trout were shipped to foreign countries. The fishes and eggs allotted to the state commissions were sent into 18 states, the eggs being hatched under state auspices and the resulting fry deposited in state or public waters.

With reference to the fishes propagated, the regular hatcheries may be classified as follows:

Marine species	3
River fishes of the eastern seaboard	5
Fishes of the Pacific Coast	5
Fishes of the Great Lakes	7
Fishes of the interior	15

The conspicuous increases over the year 1909 were in sockeye, silver and Atlantic salmon, lake trout, lake herring, yellow perch, shad, cod, flatfish, and steelhead trout, the production of the three latter species exceeding all previous years.

The lobster output from the 3 marine stations was about equal to that of 1909, while the number of cod fry produced was nearly 100,000,000 greater than in 1909.

The collection of flatfish eggs was the largest ever made by the Bureau, numbering 1,195,911,000, from which 930,000,000 fry were hatched and distributed. Other marine species propagated included pollock, haddock and mackerel.

In view of the steady decline in the shad fishery in rivers tributary to the Atlantic for the past fifteen years it is gratifying to record an increased egg collection of this species, and a corresponding increase in the output of fry. The results are partly attributed to recently enacted legislation regulating the methods of fishing in Albermarle Sound and partly to an exceedingly early spring which started the run of fish in the Potomac River before the pound nets could be equipped, thus permitting a larger number to ascend to the spawning grounds than usual.

The widespread and increasing interest in the Bureau's work by people of all sections of the country, and the growing conception of benefits resulting from the stocking of public and private waters, is manifested by the large number of applications for fish received during the year, the number being 10,635, an excess of 523 over the fiscal year 1909.

The distribution of fish during the year involved railroad travel aggregating 527,245 miles, 96,263 miles of which was covered by the six specially-constructed cars of the Bureau. The remaining 430,982 miles was made by messengers traveling in baggage cars.

DISCUSSION

PRESIDENT: The enormous increase in the output of the Bureau of Fisheries is quite impressive to me when I recall that 30 years ago this fall, when the Bureau first took up the work of hatching whitefish on the Great Lakes we were directed to use every effort to secure 20,000,000 whitefish eggs. That looked like a difficult task. I do not know how many million are hatched now, but several hundred anyway.

To hatch 20,000,000 whitefish eggs 30 years ago was considered something remarkable, but now, of course, it would be considered practically a failure. I think at that time there were not to exceed seven or eight hatching stations in the whole United States operated by the Federal Government, perhaps not that many. I mention these facts only to call attention to the remarkable progress made in practical fish culture in the past 30 years.

MR. FRANK N. CLARK, Northville, Mich.: I do not believe that we individually realize what is being done in the way of turning out fry, I mean turning out the living, swimming animals in the water. That is why I said what I did about pollution. When I first commenced work on the fish commission we had a camp at Mt. Vernon, and if we turned out 600,000 or 800,000 shad we thought we were doing wonders, and when we first commenced taking trout and whitefish on the Great Lakes I remember that with 500,000 lake trout we thought we were doing wonders. Now our station alone takes 71,000,000 and various states are doing a thousand times what the United States did in the first year. Taking the states and the nation together. we are turning out an enormous quantity of fry. When you get up to 6,000,000,000 or 8,000,000,000, that means a lot.

COMMERCIAL TROUT HATCHERIES AND THEIR INFLUENCE ON PUBLIC HATCHERIES

By Eben W. Cobb

I have taken for my subject the commercial hatcheries for the reason that they are not so often heard from as the government and state hatcheries, and also to start a little discussion on one or two points on which I believe there is a considerable misunderstanding.

That the private hatcheries have a tremendous influence in the success of our public hatcheries is very evident to one who will look over the reports from the different hatcheries.

In many places the keeping of brood stock has been a failure and the supply of eggs purchased from the commercial men is depended on almost, if not entirely, for the stocking of waters in the vicinity. This great demand for domesticated eggs is well taken care of, but the point to which I wish to call attention is the quality of the eggs supplied.

It has been customary to judge the quality of the eggs by the age of the trout from which they were taken, but let us look into the conditions under which they are raised.

A certain number of fry are kept for rearing, and a percentage of these grow rapidly and when twenty months old will weigh from one-fifth to one-third of a pound. These are a good healthy lot and will sell better in the market than at any other time, consequently they are sold. The balance of the stock kept are undersized, grow poorly, and are in a general run down condition. These are, of course, kept over as they are too small for market and it is from such fish that many of our eggs are taken. Of course it must be admitted that some men keep over a choice lot, but the chances are against it as the market demands smaller and smaller fish for table use, and by skill in feeding the rate of growth is increased.

The question which comes to us after seeing the commercial end of the business is whether eggs from first-class yearlings are not better than from second-class two-year olds. My own experience in keeping a good lot of trout over the second year showed me that better eggs were produced and also that money was lost by so doing.

I at one time had orders amounting to half a million eggs which I could not fill. The buyers demanded first-class eggs and nothing else. I took a little chance on my own judgment of good eggs and purchased half a million yearling eggs for $175 and shipped them out with a guarantee that they would be satisfactory in every way. I received $250 for them and my customers were very well pleased with the eggs they received.

Another matter that should receive more attention is the diseases of fish. These hatcheries are crowded to their fullest capacity and furnish an ideal spot for diseases of all kinds. There is practically no inspection of fish to prevent the sale of those affected with fungus, tumors, gill disease, etc. It may be true that cancerous fish cannot transmit the disease to human beings, but I personally do not care to eat them. Is it not reasonable to suppose that fry hatched from eggs from such fish will at least be more subject to disease than otherwise? Oftentimes an epidemic breaks out among our brood stock which might be traced back to a shipment of eggs.

One thing we should all do, and that is to encourage the private hatchery all we can. They supply the market with a fish which could otherwise rarely be obtained. To be sure many of the choice "speckled beauties" which reach the table are "German browns," but if the customer does not know the difference what does it matter? They provide us all with a good supply of eggs for hatching, and they take the risk in carrying over the stock. I ordered for Minnesota this season four million, without which we would have been practically out of business. As the head of the game and fish commission of one of our leading states put it this fall, "They are supplying us with eggs cheaper than we can raise them ourselves and taking all the risk—what is the use of our raising them?"

I would strongly urge that where a man wants to start a hatchery he should be given all assistance possible, even to supplying him with the first lot of eggs. Then give him an open market. Let him sell his product at all times, but have his business regulated and inspected for the protection of both sides.

The Bureau of Fisheries has been buying yearling eggs, more or less, for the last seven years at least, and as they keep an accurate record of each lot received I would like to hear how they compare with other eggs coming from the same locality.

These questions have been raised because I find dealers selling for thirty-seven and a half cents a thousand and others for one dollar and all the way between. The usual claim on high prices is that they have old trout.

My experience has been that where taken from the ponds just as they came that sometimes the best lot of eggs came from the younger fish.

DISCUSSION

President: This is a paper that strikes right home to every state commission that is hatching brook trout and also to the Bureau of Fisheries. I do not know of any state that does not buy more or less of its eggs, and the Bureau has been buying eggs for years. It is an important practical question in trout culture. As far as Michigan is concerned, I will state that for the last five years the eggs we have bought have been very largely from so-called yearling fish, that is, fish coming two years old. I suppose, of course, that is what Mr. Cobb means. We have had very good results, but there are a few dealers in the east that charge a higher price for their eggs, because they select their breeders; these are almost certain to produce excellent results. Once in a while, though not often, the yearling eggs will not turn out quite as well. That is our experience. When dealers are careful to select their breeders and take eggs only from fish three and four years old, they are almost certain to be first class without exception. I would like to hear the experience of others on this subject. My state is quite interested in it.

Mr. H. F. Hurlbut, East Freetown, Mass.: I commenced fish culture in 1888. I was a farmer and had made a success by selecting stock.

When I went into business I thought it would be a good plan to do the same thing in trout, so I have been selecting my trout from that time on.

While Mr. Cobb's paper is all right in one way, yet if a commercial man that raises trout continues to use yearling eggs his stock gets smaller all the time. I have this to say, and my experience is this, that this year we have the best fingerlings we have ever had and I think the reason is because I have selected my best trout to breed from, both males and females. While the young trout eggs may do well for wild streams, yet you put them out and do not know what becomes of them. They may do well; and I would not say they would not do as well as other trout; but the commercial man will find if he follows it up for a few years that he will be in trouble.

Last season we put into the Boston market something like 1500 pounds of trout that would not be two years old until January and February—we put them on the market weighing one-quarter to one-third of a pound. I could not do that when I commenced. I cannot get suitable recompense from the eggs from our old trout and I would not keep them at all, select them, and carry them along, with eggs at 80 cents a thousand. You know, every man that is conversant with the state hatcheries, that the state cannot produce trout eggs for less than two dollars a thousand. That is my experience in raising trout from 1888 up to the present time.

Mr. Cobb: The United States Government buys millions of those eggs from trout two years old and over; we in the states are buying millions. Your trout in the market in New York and western cities are running from one-fifth to one-third of a pound. Where do those millions of trout eggs, from fish two years old and over, that we are buying at from fifty cents to a dollar a thousand, come from? If they come from yearling trout, let us get right down to it, and not try to face an impossible condition. If it costs two dollars a thousand to raise eggs of these selected trout, we are not buying them for fifty cents nor a dollar a thousand. The United States Government I know did demand eggs from fish two years old and over. But the United States Government said nothing in those contracts about where the milt for these eggs should be obtained. The man with the strictest conscience you ever saw could fertilize everyone of these eggs with yearling milt if he wanted to; he could use all yearling males. It has the same influence on the eggs as to use yearling females.

But eggs coming from yearling trout are said to hurt the trout. I know one trout company that carried over a lot of two year old fish and was putting their eggs on the market; they sell eggs to the United States Government and the United States Government knows they are yearling eggs. I know what they did with 250,000 of them in 1907. They gave them to the state hatcheries. They were no better to hatch in the state than in the government hatchery, but the record on those eggs was one of the best the state hatchery made that year. Those eggs at least were good.

Mr. W. O. Buck, Neosho, Mo.: I have handled a good many lots of eggs from private hatcheries, and some from Mr. Hurlbut's which were very fine. But I have noticed one very decided difference in different lots of these eggs handled side by side with eggs from wild trout. There is a great difference from the first between the eggs of wild trout and those from domesticated trout. The wild trout eggs show that they are much stronger. The results, as they are carried through the season, show in their favor. It seemed to me that the same distinction could be noticed between the lots from different hatcheries, and that it was all in favor of the young trout; that is, the eggs of the young trout, although they are often smaller, looked better from the first, and did better up through the period of incubation, and the fry did better; they were more vigorous and there was less loss. I have noticed the same thing with our domesticated rainbow trout: the young fish give the better quality of eggs—somewhat smaller but more vigorous. It seems to me that Mr. Atkins' experiments with Atlantic salmon, with which I was familiar for a good many years, argue in the same direction. He took young Atlantic salmon and confined them in ponds, reared them and bred them for several generations one after another, and the vitality continually ran down. Now that may all be a question of environment, or it may be a question of food, but it seems to me it is probably a question of food, as we cannot give trout or salmon, or even our bass, their natural food. I should vote therefore in favor of the young breeders.

Mr. Hurlbut: I wish to state here the experiment I made two years ago. I wanted to see how many fry I could get from a given lot of eggs. I used the early males. I chose 10,000 eggs, took care of them, and did not lose one per cent in hatching.

I asked Mr. Clark at one time if he could tell me what was the cause of the blue sac. There was not a blue sac among my fry, neither was there a crooked fry. I will tell you how I did it. I took the eggs without forcing them at all; and was very careful to take only just those few. I put them on the screen and took care of them myself; and I raised them and did not lose 5 per cent out of those 10,000, till they were a year old. That is an experience I have had in raising trout. While I say of the young trout you may get their eggs and may have success with the fry, and it may be all right for your wild stream, it will not do for the commercial man to follow up. I have a neighbor who has been trying to put two year old trout on the market as "thirds;" but they do not come up "thirds." He has followed this one year. That is my experience in the trout business. It is not from what I have heard, but my actual experience in what I have done.

President: If anyone will guarantee us all the eggs we need in the next twenty years at fifty cents a thousand, I will recommend to our board that we turn loose every trout tomorrow morning, for that is cheaper than we can produce them until our production is increased to 10,000,000 annually. The reason that commercial dealers have an advantage over the State is that they are producing trout for market, and what they receive for eggs is largely velvet. We have to breed fish, and feed and care for them the same as the commercial man does, but we derive no revenue from them. All we get is their eggs.

Mr. Hurlbut: We do select two year olds to produce our eggs that we put on the market. We will not take this year 500,000 eggs from yearlings. They will all be from the older trout, because there is a demand for them, and because the inquiry is made whether the eggs are yearling eggs or year-and-a-half eggs.

President: I will say further that, for the last eight years at any rate, we have contemplated trying to secure an appropriation for another trout hatchery in the upper peninsula of Michigan. After investigating conditions there within the last few weeks, I recommended to our board that we establish a station there for the hatching of bass, perch and that class of fish exclusively, and buy all the trout eggs we need for the trout hatchery at the Soo. I believe that to the extent that the commercial hatcheries meet the demand, you will find the states and Bureaus depending more and more on them for the production of trout eggs, because they have an advantage; they can produce them cheaper for the reason that they are selling their stock fish and at a fancy price.

THE INVESTIGATION OF A RIVER SYSTEM IN THE INTEREST OF ITS FISHERIES

By Stephen A. Forbes

We have in Illinois a river of the same name as the state, which is in many ways one of the most remarkable streams in the country, and in no respect is it more remarkable than in its natural adaptation to the breeding and maintenance of a large and varied population of fishes and other useful aquatic animals; in none has it made a more remarkable record than in the supply of fish as food which it has produced and is now producing—not for Illinois only, but for the country at large, sending out of the state, as it does, and mainly into eastern cities, much the largest part of its catch. The annual yield of the Illinois River in fishes only is over twenty-four million pounds, worth at wholesale about $738,000. If this annual output were turned into silver dollars, and these were placed in a row, equidistant from each other, along one of the banks of the stream, there would be a dollar every year for every two feet of the river's course from its origin to its mouth.

Furthermore, we have no reason to suppose that this stream and its adjacent waters have yet reached their limit of economic yield. The effect produced on them by the opening of the drainage canal from Chicago, and the still greater effect due to the introduction of the European carp, are examples of the fact that the original condition of the stream may be largely changed for the better, and give us reason to believe that it may be made a still more important asset than now, both for the people of the state and for the general public who are the chief consumers of its product. Evidently this is one of the natural resources of the state and country which should be carefully safeguarded. A thoroughgoing, practical investigation of this stream is now especially imperative because of the great changes in progress at the present time in its environment and the still greater changes contemplated or impending, which have affected, or must certainly affect, greatly and permanently, its value for the purposes which it now serves. Reclamation projects, for the protection, drainage, and cultivation of its bottom-lands; manufacturing projects, threatening a various contamination of its waters; canalization projects and projects for the control and equalization of its flow, in the interests of transportation,—all are being earnestly agitated, and several of them are in process of active execution.

Although the problem of the maintenance and development of favorable conditions in this stream is by these facts made somewhat special, in many of its general features the Illinois is virtually like all other rivers, and a satisfactory program for its investigation would be readily adaptable, I believe, to many other streams, and applicable in its main features to rivers in general. It is for these reasons especially that I have ventured to ask the attention of this broadly representative body to my special topic, and to ask your criticism of its proposals now, when criticism can be made most profitable.

Versed as you are in the literature and accepted methods of fish culture, I scarcely need remind you that principles of management and methods of protection and improvement are not nearly so well settled for the fisheries of our natural waters as they are for fish culture in artificial ponds, and that the maintenance and utilization of our fisheries has been much less thoroughly studied for rivers, either in this country or in the Old World, than it has for lakes. This is, no doubt, in part because lake fisheries are, generally speaking, both more important and more readily controllable than river fisheries, and partly because the river problem is much the more complicated and difficult of the two. The Illinois River has, however, so many lakes in its bottom lands, merged with it in times of flood, distinguished from it successively with the retreat of the overflow, but connected with it and contributing to it at its lowest levels, and the river itself has, as a home for fishes, so many of the characteristics of a lake, that its problems, although complex and difficult, do not compare unfavorably in importance with those of any lake in the world of equal area. Its average fall through the lower four-fifths of its course is only 1 2/3 inches per mile, and there are stretches of several miles throughout which its fall per mile is only about a quarter of an inch. Its current at low water, as it swings from side to side of its broad and level flood-plain, is as slow, at the dams, as half a mile per hour, and although the midstream flow at high water is, of course, much stronger, there are even then extensive backwater shallows in which a fish could hardly tell whether it was swimming upstream or down.

It is one of the most interesting features of our field of operation that we are able to bring easily into comparison the system of life in this sluggish, lake-like stream with that of the swift Mississippi, into which it flows, or that of the still swifter Missouri, whose mouth is only twenty-four miles from its own. Even the Ohio, very different physically and biologically from either of the other three, is not beyond our reach, and comparative studies of all these streams have been begun by us this year.

In such an investigation as is here proposed, the foundation inquiry which must fix our beginning points and show where the principal emphasis should at first be placed, is this: Just what is it that we need to know in order that we may be in a position to do all that we ought to undertake, for the conservation and increase of our aquatic resources? To this inquiry I must make, at first, a general and perhaps a disappointing answer. It is perfectly evident that if we wish to maintain or to improve the conditions of life for the fishes of our rivers, we must first know what the present conditions are, and which of these are the most important to our purpose. We might, it is true, hatch young fish by the million, and throw them out by the hundred thousand, into all the sorts of waters which their species inhabit, without any precise knowledge on our part of the conditions in which they will find themselves when set free, or any rational judgment of the chance that they can survive to adult size. This sort of thing, I surmise, has sometimes been done, but I hope that it is, at any rate, done no longer, and certainly it can no longer be defended as either scientific or practical; it is simply ignorant. Intelligent plans for their improvement require that we should know the conditions under which our fishes live, and that we should be able to distinguish beneficial conditions from injurious, and important conditions from unimportant. We need to know what our fishes require in respect to the main essentials of their well-being, that is, to a suitable water supply, to oxygen for respiration, to temperature in the different parts of the year, to their food at all their ages, to breeding places, to freedom of migration and other necessary movements to and fro, and to freedom from injurious physical conditions, from poisonous gases and solutions, from parasites, from diseases, from excessive competition, especially for food, and from decimation by their enemies.

It is commonly conceded, I think, both by scientific students and by practical fishermen, that the most general and rigorous natural limitations upon the numbers of fishes are those set by their breeding grounds and their food supply, and that of these the latter is the most important. We especially need to know, therefore, what the more valuable fishes feed upon as fry, as young, and when full grown, under various conditions, and at different times of the year; where their food supply is most abundant; whether their most important food resources are at all times sufficiently accessible to them, and under sufficiently favorable conditions; what their food species feed upon in turn; and so on down through the series of forms dependent one upon another until we reach the primary sources of their food, and the conditions of its greatest abundance and availability.

Boat of Illinois Biological Station, equipped for watching movements of fish and for finding nests and fry

Next we need to know, for each important fish, its spawning times and places; where such places are to be found; whether the fry can escape from them in due season, and if not, why not, and what can be done about it; whether such most desirable spawning grounds are present in the necessary abundance and of convenient access, and if not, what can be done about that. All this involves, as it seems to me, a systematic survey and description, from the fisheries standpoint, of the whole congeries of waters—main river, tributary streams, and connected lakes—so made as to lead to a clear discrimination of their individual features as homes for fishes or places of occasional resort, and leading also to a classification of them in definite groups and kinds, each kind containing similar waters with similar surroundings. As soon, however, as we attempt to analyze, in this sense, the environment and the needs of the more important fishes, we find the essential elements of their welfare so interwoven, in one direction or another, with those of virtually all the other organisms in their neighborhood, and determined at so many points and in so many ways by the whole local system of things—biological, chemical, and physical, aquatic and terrestrial, climatic and seasonal—that there is evidently no fit way to our end except by a general survey and analysis of that system as a whole.

My proposed program of investigation begins, consequently, with a general natural history survey of the river and its tributary waters—with fishes, of course, in the lead, where they belong biologically as well as economically, since in them all the life of the waters culminates and centers. A great river system, however, is a large and complicated unit to handle as one, and the Illinois with its two hundred and seventy miles of length and its basin of twenty-nine thousand square miles, proved to be too large a subject for us to study with equal attention to all its parts. Such a river system may, however, be readily analyzed into an assemblage of situations, each situation perhaps many times repeated in different parts of the area, and a study of the river as a whole may be best organized and pursued at first as a study of these typical situations out of which the whole system is compounded. A large and varied group of such characteristic features, all readily accessible from a single center, was found at Havana, in the middle section of the Illinois basin, and in that section, consequently, much the greater part of our work on the river has hitherto been done. There we have gained, in the course of years, a fairly exhaustive knowledge of the fishes of all descriptions to be found in those waters, together with an approximate knowledge of the relative abundance of each in average years; a knowledge of the preferred haunts and usual range of the various species of fish, and some acquaintance with their annual migration movements; a mass of data concerning their associations one with another in the same situation and at the same time, and the competitions for food and other necessaries which these associations express; a fair acquaintance with both the average and the exceptional food of many of the species, including most of the really important kinds; a considerable body of information concerning their breeding habits and their spawning times and places; an accurate knowledge of both the composition and the quantity of the plankton of our streams and lakes, obtained by several years of systematic collection, measurement, and enumeration; a fairly full acquaintance with the other animals and plants of the area—those which inhabit the margin, live on the bottom, or lie buried in the mud; and a considerable quantity of very interesting and really important material illustrating the effect on the whole system of life of the Illinois River produced by the opening of the Chicago drainage canal in 1900. We have also made many studies of the waters themselves in respect to their physical and chemical characteristics and peculiarities under varying conditions and at various seasons, and have begun similar studies of the mud and other materials of the bottoms of lakes and streams.

In this general field we now need merely to finish our studies along special lines, and to extend somewhat the geographical range of our detailed survey. We shall then be both ready and free to take up special problems of immediate economic interest. Indeed, much has already been done by us on such practical problems, as may be seen from a few illustrations.

We learned a good many years ago—and this fact was first established in Illinois—that virtually all our young fishes, whatever their adult habits may be, live at first on the same kind of food. All which hatch in like situations and at approximately the same time, consequently, compete with each other when they first begin to feed. We have also learned that this first food—the minute plant and animal life of the water, called its plankton—is produced almost wholly in the backwaters. Although flowing streams often carry an enormous quantity of it, this mainly perishes presently in our great silt-laden rivers. When, as in very low water in midsummer, the contributions from the backwaters are reduced to a minimum, or perhaps wholly cut off, the plankton of the stream also falls off to little or nothing. Left to itself, indeed, even so slow a river as the Illinois would virtually empty itself of plankton in a little while. The fish-producing capacity of the stream is thus proportionate, other things being equal, to the extent and fertility of the backwaters accessible from it, and contributing to it at the hatching time of fishes. The plankton content of a stream at that time is, in fact, an excellent index to the productive capacity of the waters as a whole.

These facts have some interesting consequences, one of which is that every useless fish is an injurious one, since it competes for food, at least when young, with the useful kinds. By a useless fish, however, I must be understood to mean one which is both valueless to us and which does not contribute in any important way to the maintenance of valuable kinds.

There is a notable harmony between the time of highest flood in our great rivers, the spawning time of the bulk of our fishes, and the climax period in the development of the plankton. All coming together or following one another in quick succession, as they normally do, conditions are as favorable as possible for a large stock of young fishes. The longer the period and the larger the scale of the spring overflow, the better is the prospect for a heavy annual contribution to the population of the stream. To this, no doubt, is due the fact, clearly indicated by our recent river work, that the plankton product of the Illinois system has been greatly increased by the opening of the drainage canal from Lake Michigan and the consequent raising of the average level of the river by about three feet, this rise of river level resulting, of course, in a more widespread and longer-continued overflow.

On the other hand, nothing can be more dangerous to the continued productiveness of these waters than a shutting of the river into its main channel and the drainage of bottom land lakes for agricultural purposes. It is fortunate for our fisheries when one of these lakes comes into the possession, or under the control, of a hunting or fishing club, for this insures its maintenance. The time has come, in my judgment, when the state should consider seriously the policy of preserving adequate breeding grounds and feeding grounds for our river fishes, even if it has to acquire and maintain them, since these waters are in imminent danger otherwise of being practically depopulated.

It is another interesting conclusion from our recent work that the enormous outpouring of Chicago sewage into the upper Illinois has thus far improved rather than impaired its fitness for the maintenance of fishes. The organic wastes thus emptied into the stream are laid hold of by bacteria and protozoa, and passed up by successive steps to form the flesh and bones of fishes, and thus finally those of men. The same may be said of the organic wastes of the towns along the banks of the stream.

Still another conclusion of considerable practical interest

Launch of Illinois Biological Station, equipped for plankton investigations

may be here mentioned, although it grew out of our aquatic work outside the Illinois basin. One large section of the State of Illinois, comprising about a fifth of its area, is peculiar in the absence, or at least in the unusual rarity there, of a considerable group of fishes which are abundant elsewhere in the state and elsewhere in the surrounding territory. Now this section, the conditions of which these fishes evidently do not tolerate, is distinguished from the remainder of the state by its geological history, and, as a consequence, by the different character of its soil and of its streams. The soil is so finely divided that its particles cannot be wholly separated from the water, even by repeated filtering with the finest filter papers, and it thus remains persistently and perpetually turbid. The fishes which seem to avoid this situation are, on the whole, those which we find in other parts of the state to be relatively infrequent in very muddy water. The inference is plain that it is the permanently muddy character of these southern Illinois streams, itself due to the geological history of the district, which renders them unfit for these more sensitive fishes. Any attempt, consequently, to increase the number of such fishes there would be foredoomed to failure. Doubtless there are many other instances of the same sort to be found in other parts of the country, and it seems possible that various mysterious failures of attempts made to introduce new fishes are attributable to some such cause, not taken into account because unknown.

We have now a long waiting list of special practical inquiries which seem clamoring to be made. We need, for example, to observe most carefully the European carp, now undergoing enormous multiplication in our interior waters; to learn the details and the variations of its food and its habit under different conditions; to study the bearings and consequences of its spread and increase on the welfare of our native fishes, and on the whole system of fresh-water life; to watch for evidences of local overpopulation by it, to be suspected when the carp or its competing species fall below the average in size and plumpness, or when epidemic diseases appear among them; to follow the course of events in its principal spawning grounds, where our own observations show that tremendous losses, amounting to a local extermination of the young, may occur under usual conditions; and to determine, by the use of numbered tags, the range of the wanderings of this and other fishes, and especially to learn how far the various species usually go from the places where they were hatched. We have a rare and remarkable opportunity in Illinois to watch the progress of a biological revolution as important to the life of our waters as was the Norman invasion to the life and history of England. Fortunately, we have for comparison with present and future conditions, the materials and records of several years' systematic and connected work done on the Illinois River before the opening of the drainage canal into Lake Michigan, and when the carp was but just beginning to make its presence felt as a disturber of the then existing order.

I cannot, within the time limits of your program, go further with the development of this subject, and I must content myself with these sample fragments of its discussion. When the results of our river work began to appear several years ago, a leading American zoologist wrote me that the Illinois promised to become very soon the best known—because the best studied—of any river in the world, and we have been at work a good deal of the time since in an effort to increase still further our knowledge of that stream and the public appreciation of its value. In the face of the gigantic interests—agricultural, industrial, commercial, and political—which are now mustering along its course, with huge schemes in hand for revolutionary operations upon its channel, its banks, and its backwaters, we feel that we need all the backing and assistance we can secure from those concerned in the preservation and development of our native fisheries; and no agency, I am sure, is in a position to give us more effective aid than this old and influential American Fisheries Society. Especially we shall value your suggestions both as to subjects deserving early investigation, and as to practical measures possible and desirable on the basis of such knowledge as we now have or may presently acquire.

DISCUSSION

Professor Forbes (before reading his paper): I think myself fortunate this morning in the fact that the opening address of yesterday forenoon and the very animated and earnest discussion which followed upon that address yesterday afternoon, were in a great measure an opening up of the subject of which my paper will be a special illustration and a concrete instance. I am to deal with a specific problem in the general field of the conservation and improvement of our national aquatic resources; and the very able and comprehensive way in which this subject was handled by Dr. Townsend and the interesting and effective manner in which the discussion was taken up by Mr. Clark, Mr. Meehan and others yesterday seemed to me a happy preparation for the task which I have undertaken.

President: I do not know how the rest of the members of this Society feel in regard to that paper, but I call it a classic, and it almost seems like desecration to attempt to add to or take from it.

Dr. C. H. Townsend, New York: I do not know when I have listened to a more admirable paper at the meetings of this Society. We have long been familiar with the very remarkable fish catch of the Illinois River. There is nothing like it in the country. I am sure we are all very much indebted to Professor Forbes for setting forth the method of his admirable work and the work of his assistants in studying the biology of this river.

President: Are there any further remarks in connection with this very able paper?

Mr. John W. Titcomb, Lyndonville, Vt.: I cannot help expressing my enthusiasm at this paper. I enjoyed it very much. I wish we could have more like it from other states. It was a very thorough paper indeed.

Dr. R. C. Osburn, New York: Would Professor Forbes kindly tell us whether in his opinion sewage will not prove deleterious to other varieties of fish life in Illinois?

Professor Forbes: I suppose different fish populations would be affected differently by additions of still more dirt or filth from the contents of the river; but the fishes of the Illinois River are pretty well hardened to conditions which fish of clear lakes and streams would find intolerable. It may be that in course of time we shall find deposits on the bottom which undergo decomposition which will make them injurious; but up to the present time we have not been able to see any injurious effects at all upon the fisheries of the river or its waters as a consequence of contributions of Chicago sewage, which, however, under-goes considerable decomposition before it enters those parts of the stream which contain fish. On the other hand we have found that one important effect was to increase the amount of food for the young fishes, that is, to increase the plankton product—not merely the total product, because, of course, the volume of water is enormously greater, but to increase the amount of plankton per cubic yard of the water, so far as we can now see. Consequently Chicago has done us no harm by the waste of that great city flowing into the stream. We have been giving close attention to the matter and for the present we thank Chicago for her sewage.

Mr. Frank N. Clark, Northville, Mich: I was very much interested in this paper, particularly because I have been acquainted with Professor Forbes for thirty odd years and was engaged with him in experimental whitefish work thirty years ago. I wish that Professor Forbes could have talked further for several hours along the same line.

I would like to ask Professor Forbes if he could tell us whether the sewage from towns, sawmills, and other things of that kind is not detrimental to the fishes, or how it is that in some portions of our Great Lakes where it has appeared the whitefish have been driven out of that territory; for instance, the Thunder Bay, Lake Huron region. They were at one time caught in Thunder Bay River, but now are not found nearer than nine miles out in the bay. If the sewage has not been detrimental, why have the fish gone?

Professor Forbes: I think, perhaps, I have already given an explanation and answer to that question, when I said that our Illinois River fishes are already adjusted to conditions which the fishes of a clear lake would not tolerate. Whitefish could not live in the Illinois River; and conditions which have proved harmless to catfish, buffalo and even the bass of Illinois, would be intolerable to a whitefish. Furthermore, we have no lumber mills on the Illinois. Whatever lumber interests were there have been disposed of so that there is no waste of that kind.

Mr. Titcomb: I want to get clearly from Mr. Forbes whether he considers refuse from sawmills detrimental to fish life.

Professor Forbes: I cannot say anything about that. I have never been in situations or placed where there was any sawmill waste. I have depended for my information in that regard simply on what I have seen in print from people who have had opportunity to study that subject. I do not know whether I have the correct general idea.

Dr. George W. Field, Boston, Mass.: We have found in Massachusetts that sawdust is injurious; and in a recent letter from Professor Hofer he says investigations in Germany have shown that the presence of sawdust does not mechanically injure the fish, but there is some effect on the epidermis of the gills which makes them susceptible to other conditions, and it is indirectly very serious.

If sewage reaches the fish in the condition of nitrates it may increase the food contents of the water and thus be beneficial to the young fish in furnishing more food; but when it reaches the fish as crude sewage it must be prejudicial.

Another point in our investigations in Massachusetts is that this sewage becomes beneficial to the fish in proportion to the readiness with which it is turned into nitrates and nitrites. This change takes place most quickly on land, next in fresh water, and next in brackish water, and last of all in salt water. So the very last place in which we should put sewage, or the waste of manufactures, is in the sea or in salt or brackish water. The common municipal practice is to put this refuse in the sea, either at the shore or as far out in the sea as convenient, but that is the very worst place in which it could be put.

Mr. S. F. Fullerton, St. Paul, Minn.: I can add my testimony, without fear of contradiction, as to sawdust killing fish. My home State of Minnesota is a lumber state and I know positively of three good trout streams that have been destroyed by sawdust. There is no question but that sawdust did it, because the volume of water is as great today as it ever was.

Mr. Kelly Evans, Toronto: Perhaps some of the commissioners could tell us as to the deleterious effect on trout life of refuse (bark, etc.) left in logging streams.

Mr. Titcomb: I had no question in my own mind as to the deleterious effect of sawdust, but Professor Forbes was so clear in his paper I thought I had missed that point. There is no question of the deleterious effects from logging. We find that trout disappear in streams where logging is conducted. I presume the waters are mostly trout streams that Mr. Evans refers to; after logging ceases the trout reappear and you can get good trout fishing again. I do not pretend to say what it is that affects the fish.

Mr. W. E. Meehan, Harrisburg, Pa.: That is the experience with trout streams in northern Pennsylvania. Wherever logging is going on the streams become almost entirely depleted of trout. Like Mr. Titcomb, I do not pretend to say whether it was caused by the running of the logs or the breaking out of the splash dams. Unquestionably much of the damage was done by sawdust, especially where it became deposited; but with the cutting away of forests, the abandonment of most of the lumbering, and the restocking of those streams, they have become good trout waters again. Many that had become almost entirely depopulated are today nearly as full as they were half a century ago; and that is especially the case in one of the counties that was most roughly treated by the lumbering interests many years ago. Those streams today have reached such a point that very many of the anglers no longer keep to what is called the minimum limit of the size of the fish which may be caught, which in Pennsylvania is six inches, but discard anything under seven or eight inches, and still take their legal number of fish per day. That is the record in several northern counties where lumbering interests were carried on and where the streams became almost entirely depleted.

Mr. John E. Gunckel, Toledo, Ohio: Do I have to furnish an affidavit of what I am going to say? For twenty years since I have been a member of this Society I have been hearing about sawdust. Now, in the city of Toledo, Ohio, we lack 20,000 population of what we expected, and that is why I say we are in Ohio. There is a stream there, the

Ottawa River, emptying into Maumee Bay, in Michigan. Thirty years ago there was an old sawmill within four miles of the city limits. I was there every single Saturday for my health and to fish. That is where I got my reputation of being a truthful angler. I never caught so many large-mouth black bass and pike as I did where the sawdust came from the sawmill, and I always had success for 25 years. This last summer I was at Beulah, Ohio, along Crystal Creek; I will not stop to tell you about the black bass I caught in Crystal Creek, because they are beyond the size Mr. Clark and you are accustomed to catch. But a mile from Beulah there is a man who owns a sawmill and a trout pond; he charges a dollar a day to fish in that pond. All around the edge of the trout pond there is sawdust. But I never caught so many trout in my life as I did in that pond. I never fished there in my life without having to stop and look at the law so that I would not exceed the legal allowance. (Laughter.)

PRESIDENT: If there was any doubt about Mr. Gunckel's reputation being fully established, it has been entirely removed. (Laughter.)

MR. GUNCKEL: The reason I asked if you wanted an affidavit is because Dr. Bean is not here. If he were here, he would confirm whatever I say. (Laughter.)

MR. EVANS: My reason for endeavoring to have the members of the Society give an expression on this point is a serious one. On the 7th of October the policy of using the Nipigon as a lumber-driving stream or not will be decided. It is undoubtedly the finest trout river in the world. I am going to ask the President of the Society if he will be good enough to arrange that all remarks made upon this question of lumber operations and sawdust in trout streams be furnished to me in typewriting so that I can present them to the cabinet before this decision is made on the 7th of October. Therefore I trust that any commissioners present who have any views to give on this question of lumbering operations and their effect on trout streams will kindly give them. It is the last great unspoiled river on the continent that I know of; and I would like to get an expression of opinion as to the matter.

MR. DWIGHT LYDELL, Comstock Park, Mich: I think the Muskegon River in Michigan used to be one of the greatest lumbering streams in the United States and today it is one of the best trout and bass streams in the State of Michigan. As far as bass are concerned, they were introduced there six years ago and are being caught by the hundred. The lumbering has been done away with. I believe the last drive was four years ago. The amount of bark, sawdust, etc., dumped into the river was enormous before this, but it has had no effect on the fish there of today.

MR. MEEHAN: The mere fact that fish are present where there is deleterious material does not indicate that that material is not injurious to the fish. It is quite a common occurrence to find an abundance of fish, of a certain kind, occasionally even trout, close to waters polluted by tannery waste; and I very frequently have manufacturers, tanners and others point out to me that people fish in the neighborhood of their tanneries or other establishments and catch fish. Very true, fish very often, or probably invaribly, do not think so much about the danger to their lives as they do about getting something to eat; if they find something to eat in water containing deleterious substances they will go there, just as some gentlemen will stand around a barroom all day long and fill themselves full of alcohol notwithstanding that such a course is likely to prove injurious to their health.

DR. W. P. HERRICK, New York City: In regard to the temporary disappearance of fish where lumbering operations are carried on, it is important to stop the dynamiting of streams. It is against the law, of course, but at the same time they tell me it is almost impossible to stop lumbermen on Sunday afternoons dynamiting streams near by. That often causes disappearance of fish during operations, although that may reappear afterward.

ECOLOGICAL NOTES ON THE FISHES OF WALNUT LAKE, MICHIGAN

By T. L. Hankinson

It is well known to ichthyologists that different species of fishes live under different conditions in our bodies of water; some prefer shoals, others deep water; some spend much time near the surface; and every kind has a habitat which it prefers and in which it best thrives. Investigations to find out these habitats and the relations of the fishes to them promise interesting and important results, especially to fish culturists. Such was the chief purpose of the work on fishes of Walnut Lake in Oakland County, Mich., done by the writer for the Michigan Biological Survey in the spring and summer of 1906. With the assistance of Mr. Elmer McDonald and Mr. Ellis Michael in the field and by means of valuable suggestions from Prof. J. E. Reighard and Mr. Charles C. Adams and from a number of other scientists acquainted with methods of studying aquatic life, some results in the way of data and generalizations of ecological importance were obtained, which will be considered in this paper.*

Walnut Lake is one of the many small lakes of the more recently glaciated part of the country, which includes Michigan. It is about a mile in length and some less in width, being roughly oval with a very irregular shore-line. Its surface area was about 230 acres. The maximum depth found by the surveyors was slightly over a hundred feet. Its bottom, in the shallower water, was for the most part of a very pure marl. The drainage of the lake is poor, there being no natural outlet, but an artificial one connects its waters indirectly with those of the Rouge River. The

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*For details concerning the work at Walnut Lake see T. L. Hankinson, Report of the Michigan State Board of Geological Survey for 1907.

vegetation in the lake and on its shore had the usual zonal arrangement, which was not uniform in its distinctness in different places. The distribution of aquatic plants had a marked influence on the distribution of fish in the lake, and each of these plant zones, then, with the abyssal portion of the lake surrounded by them, formed distinct fish habitats. Each of these will be considered as much in detail as possible. We named the zones from the most conspicuous plants which they contained, and our main fish habitats were then as follows: (1) The abyssal or deep-water region, (2) the pondweed zone, (3) the shoal or rush zone, and (4) the sedge zone.

1. THE ABYSSAL OR DEEP-WATER REGION

The abyssal part of the lake was considered to be that portion of it where the water was deeper than about 25 feet, and hence it had a maximum depth which was that of the lake, a little over 100 feet. This included the greater part of the lake, all but the shoal and the pondweed zone, which together occupied a strip of water averaging perhaps near three hundred feet in width. This deep water area had the following important characteristics which influenced fish-life: absence of all but microscopic plants, chiefly diatoms; a bottom soil rich in humus, increasing in amount in proportion to other ingredients as the deepest part of the lake was approached; water quite stagnant and cold below the thermocline (which from a set of temperature readings made in August, seemed to lie at about 25 feet); and with little, if any, illumination in the deepest parts; and with considerable water pressure. A peculiar association of invertebrate forms existed here in the bottom soil, composed chiefly of large, red larvæ of midges (*Chironomus*), which were found numerous at all times and at all depths in this region. No investigations of the plankton were made, but many entomostracans and phantom larvæ (*Sayomyia*) were noted, rather incidentally.

The following species of fish were caught here: Whitefish (*Coregonus clupeaformis*), white sucker (*Catostomus-commersonii*), wall-eyed pike (*Stizostedion vitreum*), perch (*Perca flavescens*), and straw-colored minnow (*Notropis blennius*). This list certainly does not include all species present on account of the difficulty of making collections from such deep water. Lake trout have been planted in Walnut Lake by the Bureau of Fisheries and by the Michigan Fish Commission. Some have been captured since these plantings, but we were unsuccessful in getting them with our gill nets and fyke nets. Whitefish appear to be common here at all depths. Some forty specimens of them weighing from 1.5 to 2.5 pounds were caught by us. White suckers were found with whitefish in water as deep as 80 feet but appeared most numerous in less than 40 feet. Only one wall-eyed pike was taken in this abyssal region. This was caught in late summer from 45 feet and was of good size, measuring 2 feet long. Perch appeared to be sporadic in their distribution here, for only once were they taken in many settings of the fyke net, and then about a hundred were caught from 45 feet of water. Schools of their young had a pelagic habit, and were sometimes seen near the surface of the deep water. Young minnows were also noticed in such situations in August forming immense schools. Some of these collected were straw-colored minnows.

The whitefish and suckers were competing for the red midge larvæ which constituted the main food of both these fishes in deep water in April and May, during which time we made our collections of fishes in the region and examined the stomach-contents of those caught. The only other time that collecting was done here was between August 6th and 18th, and we were surprised to find the 9 whitefish then taken to have eaten only entomostracans, chiefly *Daphnia*. The suckers were still eating midge larvæ but also considerable numbers of entomostracans similar to those found in the whitefish at the time. This change of food on the part of the whitefish could not be correlated with any diminution in numbers of these midge larvæ for we found them very abundant in all bottom samples taken in this habitat; and as mentioned, they were still being eaten by the suckers. It is possible that whitefish prefer plankton food but took midge larvæ on account of a scarcity of this early in the season, but no data to show such a seasonal increase in amount of plankton were obtained. Investigations along this line should certainly be incorporated in future work on any of these small lakes where whitefish thrive. The small minnows referred to, which formed such large schools near the surface of deep water, were being eaten, to some extent at least, by wall-eyed pike, for the large specimen of this species taken in August at the time these minnows were so numerous contained several of them. Perhaps the presence of these little fishes over deep water was due to an abundance of plankton on which they were feeding. If so, their large numbers would make them a strong factor in the destruction of whitefish food; and the wall-eyed pike, in this respect, would be related to the whitefish as a benefactor. A study of the food and habits of minnows when they are numerous in a lake where whitefish live might yield some practical results.

2. THE PONDWEED ZONE

The pondweed zone is a belt of submerged plants extending around the entire lake in water from about 5 to 25 feet deep. Although the pondweeds (*Potamogeton*) were the most prominent plants here, others, principally *Chara, Myriophyllum, Ceratophyllum,* and *Naias,* were present with them in large numbers. From collections made and by observing from a boat, it was very evident that the pondweed zone was the region of most abundant and varied fish life in the lake. Perch were numerous and certainly outnumbered all species except those belonging to the family of minnows, which was represented in this zone by several species, two of which, the blunt-nosed minnow (*Pimephales notatus*) and the straw-colored minnow thickly populated at least the shallower parts of the pondweed zone seemingly at all times. Three species of sunfish were also common here, which in the order of their seeming abundance were: bluegill (*Lepomis pallidus*), common sunfish (*Eupomotis gibbosus*), rock bass (*Ambloplites rupestris*), and blue-spotted sunfish (*Lepomis cyanellus*). Black bass (*Micropterus salmoides*) were frequently seen and a number were taken in our nets. The zone is undoubtedly the chief dwelling place of this species in this lake. Darters of each of the three kinds taken by us in Walnut Lake appeared to be much more common in the pondweed zone than on the shoals. Other fish that were present in the pondweed zone at least at times but about which we obtained little information as to their numbers were: wall-eyed pike, white sucker, yellow catfish (*Ameiurus natalis*), common bullhead (*Ameiurus nebulosus*), common pike (*Esox lucius*), and whitefish.

The importance of this zone as a fish habitat makes a study of the interrelations of the fishes in it well worth considerable investigation, but on this subject we got little definite information. The food of nearly all of the fishes taken was examined to find the organisms for which they were seeking. These appeared to be chiefly midge larvæ and pupæ, May-fly larvæ (*Hexagenia* and *Heptagenia*), entomostracans, caddice worms, *Sialis* larvæ, and crayfish during April and May when most of the collecting in the pondweed zone was done. Perch appeared to be feeding mainly upon these immature midges and upon entomostracans. The smaller-mouthed sunfish, bluegills and common sunfish, were eating largely insect larvæ, principally those of May-flies, while the large-mouthed sunfish, the blue-spotted sunfish, and the rock bass seemed to be feeding almost entirely on crayfish. The few specimens of the larger predaceous fishes examined, wall-eyed pike, common pike, and black bass, had been eating perch. Although there were many minnows in this region, we obtained no evidence that they were ever fed upon by any of the other fishes of the zone. None were found in stomachs, and often they were seen in company with black bass forming apparently peaceful associations. Three whitefish were caught in some 15 feet of water in the pondweed zone in April. Their food was more heterogeneous than in those caught in deep water. It contained besides many midge larvæ, small mollusk shells and *Sialis* larvæ.

3. THE RUSH ZONE

From the shore line out to the growth of pondweeds was a shoal area with water not much exceeding four feet in depth and varying in width from a few to some five hundred feet. Lake bulrushes (*Scirpus lacustris*) were the conspicuous plants here; but they formed thick growths only in a few places. There was, however, evidence of their greater abundance in former times on the shoals now barren of them, by the presence of old rush roots and rootstocks in the bottom material, and from testimony of people who have lived in the region of Walnut Lake for many years. Two factors in the destruction of bulrushes in the lake were apparent, and these were ice and the ravages of muskrats. Small stoneworts (*Chara*) formed a scant, even, but inconspicuous growth in shallow water everywhere except in places with much sand in the bottom material or where stones were numerous.

The shoal region of the lake was much frequented by fishes small and large, but these latter were seen upon it only during the spring and early summer months, which was probably because their food, chiefly in the nature of crayfish and insect larvæ, was most abundant in shallow water at that time of year (this was apparent from our observations and collections), or perhaps in some cases they were looking for nesting places, for, as mentioned later, a number of them use the shoals for nesting. In late summer the shallow water was deserted by all but minnows and other small fishes; and these were rarely seen except where the bottom was stony or where there was much vegetation.

Shoals with these two features were at all times preferred by fishes, and those with smooth, unbroken marl bottoms, barren of nearly all vegetation, seemed to be the poorest places for fishes in the lake. Early in April, however, shortly after the ice left, minnows and darters were found quite common on these barren shoals, and at night they appeared well populated, when perch, in large numbers, could be seen with our searchlight resting here and there on the bottom; and sunfish, catfish, and black bass were often noted. Advantage is taken of these larger fishes in shallow water at night and also of those caring for their nests there, by spearmen, who carry on much of their illegal work in Walnut Lake. That whitefish come to shallow water in spring in this lake was shown by the capture of one weighing 2.25 pounds close to shore in less than a foot of water on the night of April 18th. In its stomach were some 200 midge pupæ, which were numerous near the shore at that time, and their immense swarms were present over the adjacent sedge zone.

In those portions of the rush zone where the bulrushes were forming thick patches, a number of nests of each of the following fishes were found: black bass, common sunfish, long-eared sunfish (*Lepomis megalotis*), and blue-spotted sunfish. These nests had been made in each case by the fish sweeping away the marl to form a depression with an area of cleaned rush roots at its bottom. To these roots the eggs were attached. Four rock bass nests were found on a shoal with a rather scant growth of bulrushes. There was no indication of any constructive process in any one of these; the bottom soil appeared entirely undisturbed, the " nest " being simply a protected area of the marl bottom in each case with either young or eggs on it. The latter were found in two instances and were attached to the little stonewort plants which, as before mentioned, are so generally scattered over the marl-bottom shoals. Bluegills seemed to prefer the deeper parts of shoals for their nests. Many colonies of them were found, and all were in water of about the same depth, near three feet. The other sunfish mentioned were nesting in water less than two feet deep. As in other parts of the lake, minnows of the rush zone have a relation to the other fish of the habitat which is important. They could be seen congregating about and within almost every black bass, rock bass, or sunfish nest after the eggs, which they were seen to eat and which were found in the stomachs of some of the minnows caught from these nests. Attending fish differed greatly in their abilities to keep minnows from their eggs, but in a very few cases were they successful. These egg-eating minnows all belonged to two species as far as our observations went, the blunt-nosed and straw-colored minnow, which were by far the most abundant and the most generally distributed minnows in the lake; and the two were closely associated, schooling together freely. Nests of some of the smaller fishes were found in shallow water. Blunt-nosed minnows were laying their eggs on the lower sides of flat stones where these were numerous. Several nests of Johnny darters (*Boleosoma nigrum*) were also found in like situations and also two of the miller's thumb (*Cottus ictalops*). People familiar with the lake say that whitefish come in large numbers to a certain broad expanse of gravel shoal every fall. If this be true, the shoreward movement on the part of the fish is in all probability for breeding purposes.

There were some parts of the rush zone so located that conditions were especially favorable for plant growth, and contained much aquatic vegetation of varied character. The principal plants found in the water here were water lilies (*Nymphaea* and *Castalia*), pondweeds, stoneworts, *Myriophyllum, Ceratophyllum, Philotria, Naias,* bladderworts (*Utricularia*), water crowfoot (*Batrachium*), water moss (*Hypnum*), duckweeds (*Lemna* and *Spirodela*), and filamentous algæ of several kinds. About the margins of these places or in very shallow water in other parts of them, there were commonly found bulrushes, sedges, cattails (*Typha*), pickerel weed (*Pontederia*), and swamp loosestrife (*Decodon*). These vegetation-rich shoals were much frequented by fishes where some forms were abundant at all times. Representatives of the majority of species found in the lake were seen here at different times. Golden shiners, (*Abramis chrysoleucas*), mud minnows (*Umbra limi*), chub suckers (*Erimyzon sucetta oblongus*), tadpole stone-cats (*Schilbeodes gyrinus*), Cayuga minnows (*Notropis cayuga*), and black-chinned minnows (*Notropis heterodon*) all appeared to have strong preferences for places of this character; and they were also the shoals most frequented by the young of some of the larger, more important fishes; those of black bass, sunfish, perch, and catfish were all common and often present in large numbers, especially the young perch, which were gathered in schools that were almost universally present at these places in the summer time.

The fishes were feeding chiefly on invertebrates, which were similar to those found in the stomachs of the fishes of the pondweed zone. These were midge larvæ, May-fly larvæ, crayfish, and entomostracans. Although it was not always possible to know from what part of the lake a fish got the food found in it, there can be no doubt but that the invertebrates mentioned were an important cause of the abundance of fishes on shoals of this character, and no doubt there were also other reasons for their presence, one of which was the warmer water than that of adjacent regions—a condition which we often found. Fishes also came to these shoals for breeding. Nests of black bass, common sunfish, and blue-spotted sunfish were noted here. The common sunfish seemed to prefer such places, but the others nested most frequently in rush patches.

From the examination of the stomachs of the fishes collected from these shoals with much plant life, it appears that midge larvæ and entomostracans were the chief food of the smaller fishes—minnows, darters, and the young of perch, sunfish, black bass, rock bass, and catfish. The larger fishes were taking principally insect larvæ and crayfish. The latter formed the chief food of black bass and were eaten to some extent by catfish, perch, and common sunfish. May-fly larvæ were fed upon by bluegills, yellow catfish, common bullheads and rock bass. Midge larvæ also formed an important part of the food of some of these larger fishes, and many were in the stomachs of bluegills, common sunfish, and long-eared sunfish. Other invertebrates eaten by fishes on these shoals, but from our examinations of their food did not appear to be very important in this respect, were: dragonfly larvæ, small snails, small mussels, amphipods, leeches, water mites, caddice worms, and certain protozoans (*Arcella*). Some fishes were fed upon by others. Least darters (*Microperco punctulata*) were found in two young black bass, each 2.5 inches long. Common pike were feeding upon young perch and darters. As in other habitats studied, minnows did not appear to furnish any part of the food of other fishes. Vegetable matter in the form of filamentous, green algæ was found in the intestines of some minnows, and it formed a large percentage of the food of the golden shiners taken on these shoals. A black bass, 9.5 inches long, caught in a little bay where there was much water moss (*Hypnum*), had a mass of this in its stomach, which it may have taken with crayfish, remains of which were mixed with it.

4. THE SEDGE ZONE

Almost encircling the lake was a strip of low ground extending back from the shore to the region of high ground from a few feet to some three hundred feet. Sedges were the chief plants on this low ground. A noticeable relation that this zone had to fishes was through harboring insects which furnished them food. Important among these were midges and May-flies which laid their eggs in the water to produce larvæ that were fed upon extensively by fishes. In late summer grasshoppers were numerous in this zone, and now and then one would fall in the lake to be snapped up by some fish. We often noticed such a fate coming to these insects. Bluegills could often be seen resting near the surface of the pondweed zone looking for surface insects of which grasshoppers constituted a large proportion. A few of these fishes taken in late summer had many grasshoppers in their stomachs.

In early April flooded portions of the sedge zone were used by pike for breeding purposes, and large individuals were sometimes found getting around in the shallow water among the sedge plants with much difficulty. Gunners look for them at such times and thus undoubtedly do much toward diminishing the numbers of this important game fish. Schools of minnows on a few occasions were seen far from the lake swimming in a few inches of water among the sedge plants. At the lakeward margin of a part of this zone in early April just as the ice was leaving the lake, many small fishes were found hidden in the submerged portions of sedge tufts. These were mostly blunt-nosed minnows, but a Cayuga minnow and a few *Etheostoma iowæ* were found here.

SUMMARY

The results of the work at Walnut Lake that seem to be of especial importance are here summarized:

It is a type of lake fitted to support whitefish. Some of the conditions there favorable for them, appear to be plenty of deep water with much of it at a low temperature throughout the year and abundance of food in the form of larval midges in the bottom material everywhere that other conditions are favorable for these fish.

Midge larvæ appear to be the most important articles of food for the fishes in Walnut Lake.

May-fly larvæ (*Hexagenia* and *Heptagenia*) are important food for those sunfish with small mouths like the bluegill and common sunfish.

Crayfish are eaten extensively by black bass, and probably form the chief food of this species in the lake.

Minnows appear to be unimportant as food for other fishes in the lake, but seem to be detrimental to the general welfare of the better fishes there by eating the eggs of some of them and feeding upon midge larvæ and entomostracans.

Shoals with much varied vegetation are favorite feeding places for the young of black bass, perch, sunfish, and catfish.

Rush patches form good breeding places for black bass, common sunfish, long-eared sunfish, and blue-spotted sunfish. The roots of these plants are used to hold their eggs.

The pondweed zone is the most important region in the lake as a fish habitat.

Shoals with stony bottoms are preferred by darters and some minnows, including the most abundant species in the lake, the blunt-nosed minnow. This species breeds upon shoals of this character.

THE STUDY OF MARINE ECOLOGY AND ITS IMPORTANCE TO THE FISHERIES

By Roy Waldo Miner

Ecology is that subdivision of biological science which deals with the relations between organisms, or groups of organisms, and their environment, as well as their economy and manner of life.

The facts connected with plant relations and those of animals, though overlapping at certain points, are in the main widely divergent because of the dissimilar physiological and morphological characteristics of the two groups. Accordingly the general subject of ecology in turn may be subdivided into *plant ecology* and *animal ecology,* though in either case, the organisms of the other kingdom must be regarded in a secondary way as a portion of the environment.

Thus in the study of the ecology of a given animal we must consider not only the other animals of its neighborhood, but its plant environment as well, and finally, we must note the bearing of its inanimate surroundings upon its life and activities.

The side of animal ecology with which we are concerned in this paper is that which centers about the life in the seas, and may therefore be spoken of as marine ecology. Marine life falls naturally under two heads, (1) oceanic and (2) littoral.

1. OCEANIC ECOLOGY

That the waters of the open ocean swarm with countless organisms has been realized with growing appreciation ever since the middle of the past century when Johannes Müller began the use of the "fine surface net" to obtain the material for his studies on echinoderm larvæ. The wealth of minute and hitherto unknown sea creatures which was brought to light with each haul of the net aroused zoologists to the fact that a new world was open to them—a world comprising a life of such extent, beauty, and diversity of form and habit that its exploration was undertaken with the greatest enthusiasm; and the next thirty years, from 1850 to 1880, witnessed marvellous additions to knowledge of the sea fauna, though the classical discoveries of Huxley, Häckel, Kolliker, Leuckart, Gegenbauer, Agassiz, and others. These in turn led to or were concerned with the organization of important governmental exploring expeditions, especially those conducted under the auspices of the United States, Great Britain, Germany, France, and Norway. The most important of these, however, was the epoch-making *Challenger* expedition of 1873 to 1876, under the direction of Sir Wyville Thompson and Sir John Murray. The results of this voyage were most far-reaching, not only in the great number of new species brought to life, but also in the development of knowledge regarding ocean conditions and the extent to which animal life peoples the sea and its bottom. Since 1880, the United States and practically all the European nations have engaged in a continuous series of hydrographic and zoological deep-sea expeditions by means of which knowledge of the ocean and its fauna has rapidly increased up to the present. To enter into details regarding these voyages and their results is beyond the limits of this paper. We may, however, briefly recall certain general features of the life of the sea as it appears in the present state of our knowledge.

Oceanic life may be considered under three heads—(a) the floating organisms or *plankton,* (b) the swimming fauna or *nekton,* and (c) the animals and plants living upon the sea bottom, known collectively as the *benthos.*

(a) The *plankton* consists of myriads of floating creatures, mostly of small size, including especially countless protozoa and unicellular plants, which in swarms of varying density and great extent, seem to people the entire ocean. Agassiz, as a result of his observations during the voyages of the *Blake,* maintained that this population is mainly confined to within one hundred fathoms of the surface, but the subsequent invention of the automatically closing net made is possible to demonstrate that plankton exists at all depths of the sea. The extent and composition of this great ocean life is not constant, but is dependent upon seasonal variations, fluctuating from day to day, from month to month, and from year to year. Its composition though not its quantity, according to Häckel, varies with the climatic zones from the equator toward the poles, while the oceanic currents exert a marked influence on its movements and therefore affect its density. The so-called "zoöcurrents" or "animal streams" described by Häckel and others are narrow currents in the sea crowded with masses of swiftly moving plankton so dense that they appear like "smooth, thickly populated, animal roads" extending conspicuously for miles through the otherwise wind-roughened waters.

Sometimes the animals composing the plankton are extremely varied and include hundreds of species, not only foraminifera, radiolaria, and minute larval echinoderms, mollusks and fish eggs, but also animals often attaining a larger size, such as medusæ, scyphomedusæ, siphonophores, ctenophores, pteropods and small fishes, all carried about at the mercy of the waves. At other times great stretches of sea extending for miles may suddenly swarm with individuals of a single species in countless numbers, which in the course of a few days or even hours will as suddenly disappear.

(b) The *nekton,* on the other hand, comprises the larger swimming animals such as fishes and the cetacea which, because of their size and strength, unlike the helplessly floating plankton, are able to cope with the ocean currents and swim largely according to their own will. These form a group having a well-marked economic part in the ocean life, since they are actively engaged either in preying directly upon the plankton, which are thus consumed by the million, or in devouring fishes which in their turn have fed upon plankton. Thus the latter group is the most important determining factor in the food supply of the larger marine animals.

(c) The *benthos* is the term applied to the third class of organisms in the ecology of the ocean, namely, the dwellers upon the sea bottom. The conditions of deep sea life involve various factors not operating at the surface, such as enormous pressure, lack of sunlight, etc., and these profoundly affect the structure and activities of the deeper benthal fauna. The most fundamental ecological factor, in this association, however, is the actual sea bottom itself. This element confines the life-activities of many of its inhabitants more completely within the horizontal plane than do the influences limiting plankton, the individuals of which move freely in three dimensions between the ocean surface and sea-floor. With this difference in habit is correlated the animal form. While the plankton tend to be either spherical, disk-like, or top-shaped, that is, of a form adapted rather for flotation than for progression in a definite direction (e.g. radiolaria, medusæ, scyphomedusæ, siphonophores), among the benthal animals, on the contrary, only those typically attached, or derived ancestrally from attached forms, exhibit radial symmetry, while the creeping habit of the independent bottom forms as well as the secondarily acquired swimming habits of the nekton, are correlated with the development of bilaterality and cephalization.

Many of the deep-sea animals, especially those which, like the bottom fishes, have a body cavity into which the water does not penetrate, are constituted so as to withstand enormous pressure at great depths. Another peculiarity of the benthos is the extent to which phosphorescence runs riot, and there seems good ground to believe that, instead of intense darkness, the sea-bottom is bathed with a phosphorescent glow, which in a measure takes the place of sunlight, and gives sufficient illumination for animals possessing eyes to see their way about.

With reference to the all-important food relation, the animals of the benthos may be either predatory in habit, feeding upon each other, or they may be scavengers, but ultimately their food supply is either directly or indirectly derived from the plankton of the ocean above them, the countless individuals of which, momentarily dying, continually rain down their tiny mote-like corpses to the ocean floor, where they are immediately devoured by sessile animals, such as actinians, hydroids, pelecypod mollusks and tube-building worms, while many of these in turn become the food of bottom-fishes, crabs, snails, echinoderms, and other predaceous creatures. Since, however, much of this planktonic shower is consumed in transit and reaches the bottom much diminished in volume, the benthos of the deeper ocean must likewise be limited in abundance as compared with that of the shore.

2. LITTORAL ECOLOGY

The ecological conditions of the marine fauna of our shores stand in sharp contrast to those of the oceanic waters, on account of their far more complicated character. In the open sea, conditions of temperature, depth, currents, etc., are comparatively uniform, and are spread over vast areas, while changes are relatively gradual.

As we approach the shore, and arrive at the limits of the continental shelf, the sea bottom rapidly rises from a depth averaging two miles or more to that of about 100 fathoms. At the same time we come within the influence of the variable local currents, while the action of the tides and the influence of the waves become more marked. Other important factors, with a direct bearing on the character of the littoral fauna, are the reduced pressure of the shallower areas and the penetration of the sun's rays to the ocean floor. The waters of the ocean also become greatly modified in the neighborhood of river mouths, where their salinity and density are diminished by the volumes of fresh water continually poured forth. The temperature of the water too is more variable, as it ranges between greater extremes of heat and cold during the year, and is more subject to frequent temporary and sudden changes because of the influence of land conditions and the shallowness of the waters affected.

The character of the littoral sea-floor differs widely from that of the deep seas. More than half the entire oceanic bed is covered, often to a great depth, with a continuous layer of radiolarian and globigerina ooze, composed of millions of skeletons of protozoan plankton, which have gradually been deposited during the geologic ages, while the deepest portions are covered with a layer of red clay. Hence the deep sea bottom presents comparatively uniform conditions.

But in the shallow waters near the shore diversity instead of monotony is the keynote. In one place swift tidal currents have scoured the bottom, laying bare the rocks. In another a river is depositing its cargo of silt, which when opposed by tidal action forms bars of mud and sand. Elsewhere, the winds and waves have eaten away the terrestrial soil from promontories, leaving a boulder-strewn sea margin, while the tidal currents carry the loosened soil into sheltered harbors where it is dropped to form mud flats. On coasts like those of Maine, cliffs rise out of the sea, their walls full of crevices, pockets, and caverns, which become more hollowed out by the waves. The constant grinding of rock fragments, too, reduces granite and quartz to fine sand which, deposited over the sea bottom, is here and there washed up by the waves to girdle exposed reaches of shore. Such is the setting for the littoral fauna that fringes our coast. Let us briefly consider some of its general features.

The diversity of the inanimate coastal conditions is reflected in the fauna, and is expressed largely in specializations to the respective environments. Each typical locality becomes, as it were, a center.

As in the oceanic association, the shore fauna may be classified into plankton, nekton, and benthos. The plankton of our northern coast differs from that of the deep sea in that there are relatively few of the larger floating animals, being composed almost exclusively of diatoms, unicellular algæ, infusorian protozoa, small medusæ, copepods, and the eggs and larvæ of other littoral forms. The unicellular algæ and diatoms are especially abundant, and in the neighborhood of river mouths much fresh-water plankton is added, as well as masses of minute particles of decaying organic material. The richness of this plankton as food material is well brought out in James Ingraham Peck's admirable paper on "The Sources of Marine Food."*

The littoral benthos in general differs from oceanic benthos: (1) in that bodily structure is not specialized to withstand great pressure; (2) as the littoral sea bottom is comparatively well lighted by the rays of the sun, there is not such a tendency to phosphorescence as in deep sea life; (3) the great diversity of littoral life is in harmony with the varying character of its substratum; (4) the coastal area is much more crowded than the oceanic floor on account of its shallowness, its more limited extent, its rich food supply, and its great diversity of life.

Other important ecological factors are the rise and fall of the tide, laying bare entire animal associations twice a day, the effect of the waves and coastal currents on exposed shores, and of the brackish waters near river mouths.

On muddy bottoms, we find animals adapted to burrow either for protection or food, especially worms and mollusks, as is the case also in more sandy tracts, with a somewhat different range of species, while in rocky crevices and tide-pools animals like hydroids, sea anemones and sponges abound, anchored safely by holdfasts and clinging organs, while echinoderms and crustacea lurk in crevices. The various seaweeds peculiar to such situations, and the hydroids as well, shelter hosts of small forms—worms, nudibranchs, snails, pycnogonids, amphipods. Every niche, every possible locality, is occupied, wherever indeed a livelihood may be gained, and its possession is fought for. Crawling, running, and swimming everywhere are the scav-

* Bulletin United States Fish Commission for 1895, pp. 351-362.

engers—snails, hermit-crabs, shrimps, and prawns. The entire economy of the waters is filled and delicately balanced, not a link is wanting.

The nekton, too, is present, including most of our important food fishes, for the rich pasturage of the shore attracts them in its season, and part feast on it gluttonously, while others feast on the feasters. Some are there for depositing their eggs, that their young may hatch in the midst of plenty, others, instinctively fearing the multitude, search for secluded places. Some, like the salmon and sturgeon, ascend the rivers to their very sources to give the coming generation a chance to develop as far as possible from the hungry horde. Everywhere the devourers intensify the struggle for existence, and yet at the same time each searches out the locality best suited for its specific peculiarities, and when that is found the struggle renews with those of its own kind or with others of similar needs. Thus the already specialized littoral fauna becomes more and more interlocked with its environment, until some disturbing or eliminating factor, some sudden change of temperature, perhaps, causes the temporary disappearance of a link and the balance is upset, only to be reëstablished along other lines. And here again the food relation brings us back to the plankton as the ultimate source of nutrition. An excellent illustration of its inevitability is quoted herewith from Peck's researches on the squeteague: "On the morning of July 23d there was taken a large specimen (of squeteague) whose stomach contained an adult herring, in the stomach of the herring were found two young scup (besides many small crustacea), and in the stomach in one of these young scup were found copepods, while in the alimentary tract of these last one could identify one or two of the diatoms and an infusorian test among the mass of triturated material which formed its food. * * * And the food of the squeteague must be regarded as a complex of all these factors, a resultant of several life histories to a given environment." A contrasted instance to this is that of the menhaden, that great food-fish for food-fishes, which itself feeds directly upon nothing but the microörganisms of the plankton.

The deduction from all this is obvious. Life in the seas, as elsewhere, must be regarded not as sets of unrelated phenomena, but as a totality, a unit, composed of interlocking parts or associations, centering around various conditions of habitat, but yet overlapping into and reacting upon each other. From this point of view no species or group of species can be considered without reckoning in its entire environment; no animal, no matter how valueless it may superficially appear, can on that account alone be considered insignificant in the economy of nature, nor for that matter in the economy of mankind. For man himself stands to the totality of the living world precisely as any other species of animal, except perhaps in that he is its greatest disturbing factor.

No one knows better than the fish-culturist how impossible it is to consider our food-fishes apart from their food and their enemies. The balance must be made to weigh in favor of the food supply until the race is propagated, or that race will be exterminated by its enemies. Therefore is it not just as important to consider the *food of the food* of the food-fishes and the enemies of their enemies? The whole is a connected and inseparable series. And disturbance in a single link of the chain must be felt along the whole line.

Inasmuch as the lower inverbrates, including the plankton, form such a close connection with the food supply of our fisheries, the writer believes that a series of ecological studies concentrated on typical invertebrate habitats along our coast would go far toward increasing our knowledge of this great food source and its practical application to the fisheries, to say nothing of the purely biological problems involved. How interesting are these latter problems is well shown by C. B. Davenport in his interesting paper entitled "The Animal Ecology of the Cold Spring Sand Spit."*

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* Decennial Publications of University of Chicago, vol. x, pp. 157-176.

The region between the tides and within wading distance of the low water mark is especially well adapted to this kind of work. For the various members of the association can here be studied to greatest advantage; and each sand-bar and muddy cove, every rocky, boulder-strewn, tide-beset point acts as a center for that association of animals best suited to its nature, and therefore as an ecological unit in the sum total of oceanic food supply.

That this close dependence of the fisheries on the study of ecology has long been appreciated by the United States Bureau of Fisheries is evident from the extensive biological and fish-cultural researches along our coast in which its staff has so successfully engaged for so many years past.

The public at large, however, is so accustomed to regard the individual animal as a unit in the natural world, that considerable misapprehension is prevalent as to the importance of researches on other than the socalled "useful" animals. Every possible means should be taken to correct this fundamental error, and to emphasize the economic position of the animal *association* rather than the *individual* in the economy of nature. With the spread of this point of view there would come about a more intelligent coöperation on the part of the public with the efforts of the government and of the fisheries organizations of the country to preserve, propagate, and properly utilize our marine and aquatic resources, and would facilitate the legislation needed to realize these ends.

This same idea of interdependence and that the individual and not the association is the unit among animals should also be one of the most emphasized lessons in the nature study of our schools, that the coming generations, in whose hands will be the progressively more crucial conservation problems of the future, may grow into their responsibility with this point of view of the natural world as a part of their initial equipment. The American Museum of Natural History is already making definite efforts along this line of education, by installing ecological groups representing typical invertebrate animal associations, in which the ideas above expressed are graphically set forth for the benefit of the public.

DISCUSSION

Dr. B. M. Briggs, Brooklyn, N. Y.: As I have attended these meetings, it has come home to me that we should commence with the children and instruct them. We all know that forces are equal and opposite, and unless we get heads to absorb these problems we will not be able to get at them, and we ought to start with children in the schools and teach them all the way up. This admirable paper has told us about the adaptability that may be learned in the waters. I think that is taught more in the waters than on the land; that the waters are more full of life and the life therein teaches us how to carry our lives; and if this Society could make an effort to teach the children in schools and colleges along this line, it would be well. We have seen how forestry has been taught in late years and the good it has done. Now we have hardly scratched the ground in this department.

Only a couple of years ago, I think, people that ought to know better took two or three cans of cod fry to Jamaica Bay, cut a hole in the ice, and dumped them in. They came to naught. It was like dumping a lot of corn on a rock, and saying we planted so much corn in the field. It goes in the statistics but nowhere else. And so if those who are supposed to know know very little, how are others going to know, and how is the problem of the food supply going to come to fruition? We should today start something here on that line.

Prof. R. C. Osburn, New York: Something of this kind is being done in New York City. The Aquarium supplies some 350 of the public schools with balanced aquaria, such as you see about the room here, for the study of some of these things in a simple way, namely, of the balance of animal and plant life in a small aquarium, and what forms will get along peaceably with other forms, and incidentally what forms prey upon one another. That is a simple thing and merely a beginning; but it shows that the question is being taken up—at least, a beginning is being made by the New York schools in this matter.

THE ALASKA FISHERIES SERVICE

By Barton Warren Evermann

The Alaska Fisheries Service, Bureau of Fisheries, is just now in the process of development or organization, and in order to understand just what that service is or what we hope it may be, let me give a short account of the various constituent parts which will compose it, or which we hope will compose it.

Up to five years ago the salmon fisheries service of Alaska was in the hands of the Treasury Department. The Bureau of Fisheries had nothing directly to do with the salmon fisheries of Alaska except in a general way.

But five years ago that service was transferred from the Treasury Department to the Department of Commerce and Labor and placed in the Bureau of Fisheries of that department. That service then consisted of an agent and an assistant agent. A little later a salmon inspector was added by Congress, and now that branch of the work is in charge of an agent, our own Mr. Marsh filling that position, an assistant agent, Mr. John N. Cobb, and a salmon inspector, Mr. H. C. Fassett.

The fur seal service remained with the Treasury Department until a little less than two years ago. At the end of December, 1908, it was transferred from the Treasury Department to the Department of Commerce and Labor and placed in the Bureau of Fisheries in that department.

At that time the fur seal service was handled in this way: the Government leased the seal islands to a commercial company. The first original lease was made forty years ago. At the expiration of twenty years a new lease was entered into with a new company. The first company was the Alaska Commercial Company; then twenty years later, or in 1890, the North American Commercial Company was given the lease to kill seals on the seal islands.

Now under the terms of that lease the North American Commercial Company was given the exclusive privilege to kill seals on the seal islands in Bering Sea. In return for that privilege the company agreed to do certain things—agreed to pay the United States Government a certain royalty, a certain amount of money, for each seal skin taken on the islands, and to maintain on the islands houses in which the natives might live. The natives, about 300 of them, on the two islands of St. Paul and St. George, are depended on to do the killing and various other kinds of work connected with the business.

The company was also required under the terms of the lease to maintain a school on each island and a competent teacher to conduct that school, to maintain upon each island a competent physician to look after the physical welfare of the natives, and to maintain a store on each island at which the natives could buy such things as they wanted.

The company pursued its privilege, of course, under certain regulations or restrictions established by the Treasury Department, to kill seals on the islands. The Government from year to year determined the maximum number of seals that might be killed, and that quota was not to be exceeded under any circumstances. In the early days the limit was 100,000 skins, of young males in every case, never females and never pups and never old seals.

But when pelagic sealing began in the late 70's or early 80's, that brought into the question a new factor. So long as killing could be limited to the islands it was easy to regulate the business, to determine how many should be killed, to determine how many should be saved; just as a man who has a flock of sheep or a herd of cattle could determine how many breeders he ought to reserve each year in order to keep his herd or flock up to a certain maximum size. That is the way the business was conducted on the islands. Only young males were killed; and the treasury agents who were upon the islands, with their advisors, did the best they could to determine how many breeders should be reserved; and that included all the female seals without any exception whatever, and included a sufficient number of males to serve those females. Bear in mind that the fur seal is polygamous and not as many males are needed as females.

The lease of the North American Commercial Company expired at the end of last April. Just before the expiration of that lease the Government considered the advisability of renewing the lease or not. The conclusion was reached that it would be better under the circumstances for the Government not to renew the lease but to take over the entire business. So on the twenty-first of April Congress passed a bill which provided for taking over the entire sealing business so far as the islands are concerned. The lease was not renewed.

Taking over the business then meant this: that the United States Government must maintain upon the islands the necessary equipment for carrying on the sealing business on the islands; it must provide food and clothing for the natives; it must provide houses in which they may live; and it must have the salt houses and the boats and all the paraphernalia necessary to carry on the business. The houses in which the natives lived belonged to the North American Commercial Company; everything on the islands except a Government house and a few other things on each, belonged to the North American Commercial Company. So it was necessary to take over those buildings or raze them and erect others in their places.

Now Congress made an appropriation of $150,000 with which to carry on the business this year. That $150,000 is being used in these ways: To defray the expenses of the purchase of the necessary food and clothing to send to the islands for the use of the natives; to defray the expense of transportation; the Government had no vessel so we had to charter a vessel to take the supplies to the islands; that $150,000 includes the amount which it will be necessary to pay the North American Commercial Company for its equipment on the islands; and that matter is being adjusted now, an effort being made to arrive at an equitable price or figure for the company's property.

The United States must also furnish a school teacher on each island; that it must furnish a doctor on each island, and that is being done.

Congress went a little further and provided a resident naturalist for the seal islands and we have sent up such a man now. That is a new step entirely. Many think, with reason, that the fur seal question, so far as the management of the herd on the islands is concerned, is largely, perhaps almost wholly, a natural history question; that the herd should be handled and managed in an intelligent way just as a man who has large stock interests, cattle or sheep or hogs, would act wisely in giving that herd or flock the most expert care that he could give it; that he would employ a man who knows how to handle stock, who is interested in the breeding of stock and who knows the things that ought to be done in order to secure the highest degree of efficiency and productiveness in that flock or herd.

We hope to do something of that kind with the naturalist who has gone to the islands, so far as the fur seals are concerned; to study them from the point of view of natural history and stock breeding.

Hundreds of interesting questions of course open up when we begin to consider that question. Can anything be done in the way of selective breeding; can the herd be improved by that means; can anything be done in the way of feeding or in the way of improving the physical and biological condition on the various rookeries?

There is on each island a herd of blue foxes, and the blue fox skin is quite as valuable as the fur seal skin. On St. George the number is considerable. The number taken each year now is inconsiderable compared with the number taken in past years; but there is no reason why the blue fox herd on St. George may not be increased to the same degree of productiveness which it at one time had; and that is a problem you see for the naturalist to handle; that is one of the problems we expect him to solve, if possible.

The transfer of the fur seal service to the Bureau of Fisheries brings to the Bureau, of course, a vast amount of new work, not only a vast amount of legitimate work but during the last few months it has entailed a considerable amount of absolutely unnecessary, absurd work, or rather work that was necessary in order to meet absurd statements made by various persons who, because of only partial knowledge, do not approve of the Government's fur seal policy.

Now the commissioner's hope is to organize the fur seal service and the Alaska salmon service into a unit; into a service which he hopes to call, or thinks of calling, the Alaska Fisheries Service; but the fur seal service, the Alaska salmon service and the steamer *Albatross* must be considered together, because the *Albatross* is on the Pacific Coast and needs to do more work in Alaska with these two propositions than anywhere else on the west coast, and would logically be attached to that service.

One other phase of the question is this: In transferring the fur seals to the Bureau of Fisheries, Congress rather curiously transferred all the other fur animals of Alaska except the brown bear. The brown bear was excepted because it had already been placed with the Biological Survey of the Department of Agriculture; and we are glad to leave it there. We wish they had all the other bears; but they are with us now.

The law as it stands makes it unlawful to kill any fur-bearing animal in Alaska, but it authorizes the Secretary of Commerce and Labor to establish open seasons. The law makes everything closed but authorizes the Secretary of Commerce and Labor to establish open seasons when the various fur-bearing animals may be killed. Bringing the sea otter, beaver, mink, weasel, foxes and black bears under the control of the Bureau of Fisheries rather nonplussed us for a time. Those were new propositions, but we looked upon it in this way: if those animals are to be placed with us we must jump into the game and do the best we can with them, and we are going to try to do that. The Department has already issued a set of regulations under which certain of the fur-bearing animals may be killed. All sorts of protests and commendations have been received already from various parts of Alaska. From the same region have come protests from some people that the closed season for the muskrat is absolutely ruinous to the Indians in that region, because they could not catch a muskrat during the open season, and from other people come other protests saying the open season is too long, that we should begin a month later in the fall and close a month earlier in the spring; all of which suggests that the regulations may not be very far from right.

You will be interested, I think, in some specific features in the regulations. The sea otter is the most valuable fur-bearing animal in the world. Last year, I believe, the total catch in Alaska was 37 skins. When the pelt of an animal is worth $250 to $800 it is going to be sought for most assiduously; and the seeking for sea otters in Alaska last year by the hundreds of Indians, squaw men and others, resulted in the capture of only 37. That is significant of this fact, that the sea otter is getting pretty scarce and needs protection. So one of the regulations establishes a closed season on the sea otter from now until November 1, 1920; and we have also established a closed period for five years on the beaver, which is getting scarce in Alaska. Information received from the various Canadian provinces shows that closed periods there have worked wonderfully well, in Assiniboia, Saskatchewan and those regions. Then a closed season is made each year in the case of the minor fur-bearing animals.

The first circular that was issued this year will be modified from time to time so as to square with the increased information that we get from time to time. But it is certain that this minor fur-bearing animal proposition is one of the most interesting that has come to the Bureau for many years; and it is a question which will have to be handled with a great deal of care and judgment it seems to me.*

* The sundry civil bill, approved March 4, 1911, made provision for a new division in the Bureau of Fisheries to be known as "The Alaska Fisheries Service," essentially as suggested in this article, to become effective July 1, 1911. This service will include the fur-seal fisheries, the Alaska salmon fisheries, the fur-bearing animals of Alaska, and all other matters pertaining to the fisheries of Alaska.

AN EXPERIMENT IN FUR-SEAL CONSERVATION

BY BARTON WARREN EVERMANN

For a quarter of a century the "fur-seal question" has been one of the most serious problems with which the Department of State at Washington has had to deal. So long as the killing of seals was confined to the land on which they haul out during the breeding season there was no difficulty; but when certain people in British Columbia discovered that fur-seals could be killed in the open sea in sufficient numbers to make the business very profitable, then trouble began. This was in the early 80's. Pelagic sealing, as killing seals in the open sea is called, developed rapidly and it was only a few years until the very existence of the fur-seal herd as a commercial entity was seriously threatened.

The killing of seals on the islands can be, and always has been, carefully regulated by the Government. In the first place it must be understood that the fur-seal is a polygamous animal, like sheep, cattle or domestic poultry. While the sexes are born in approximately equal numbers, one male to every thirty to fifty females is adequate for breeding purposes. The surplus twenty-nine to forty-nine males are not needed and can be killed without in the least endangering the existence of the herd. There is no more reason for refraining from killing each year the surplus male seals than there would be in a stockman saving all the rams or roosters on the ranch. It has therefore been the policy of the Government never to kill any female seal but to kill each year the surplus young male or bachelor seals after reserving a sufficient number for breeding purposes.

In this way the Government was able to conserve the herd at high efficiency and at the same time permit the killing of about 100,000 young male seals each year. yielding an annual revenue to the Government of about $317,500. That number now would yield a revenue of more than a million dollars annually.

But pelagic sealing is different. The pelagic seal hunter cannot distinguish between male and female seals or seals of different ages in the water; he would make no distinction if he could. Every and any fur-seal he sees is proper spoil for him; none is allowed to escape, whatever the sex or age. And experience and the records show that vastly the greater part of the pelagic catch each year consists of females. Every female seal killed in the open sea means not only her death and that of her unborn pup but also that of the pup which she leaves on the rookery when she goes out in the sea to feed. Every time a female seal is killed in the open sea after the first of July a fur-seal pup is left to starve. Since pelagic sealing began some thirty years ago hundreds of thousands of pups have starved miserably on St. Paul and St. George.

The possibility of saving these motherless pups from starvation has often been considered and several attempts have been made to induce them to take artificial food. All such attempts failed utterly. Every pup experimented with refused absolutely to take any kind of food although various and ingenious devices were employed to induce or force them to do so. Similar attempts with older or adult seals also failed. They chafed under restraint or confinement, refused any and all kinds of food, and finally died of starvation.

Apocryphal tales may be heard on the Pribilof Islands of fur-seals having been tamed and living thereafter in the houses of the natives of the islands. In the early seventies the Alaska Commercial Company brought down from the islands two immature live fur-seals, their exact age not definitely known, and placed them in Woodward's Gardens at San Francisco, but they died of starvation after several months' incarceration, having eaten nothing during the interval. This experiment at Woodward's Gardens, and all other similar attempts, fixed the belief that fur-seals in captivity could not be induced to take food.

Recently, however, the experiment was again tried and with complete success. The effort had its inception in the desire of Dr. Fox, surgeon of the revenue cutter *Bear,* to ascertain whether the fur-seals are infested with ectoparasites. For this purpose a starving pup, whose mother had been killed by the pelagic pirates while feeding at sea, was given to the *Bear's* surgeon. After having been examined by Dr. Fox the half-starved little animal was turned over to Mr. Judson Thurber, the *Bear's* boatswain, who desired to attempt feeding the pup by artificial means. He was so far successful that he induced it to eat dried fish from his hand, and kept it for three weeks when it died in convulsions. Desiring to have the experiment carried further two well-conditioned fur-seal pups, a male and a female were obtained on Gorbatch rookery, St. Paul Island, and furnished to Boatswain Thurber on October 9, 1909. Mr. Thurber began his experiments by forcing condensed milk down the throat. On October 19, the female began eating solid food. Each of the pups experienced some difficulty in swallowing solid food, due, the boatswain thought, to the fact that the tongue was tied down too firmly by the membrane or frenum which binds it to the floor of the mouth. He was led to this opinion by observing that the female pup ate more easily after breaking the membrane loose. He then tore loose the frenum of the male's tongue with the result that he, too, began to take food more freely.

In conducting the experiment Mr. Thurber showed no little skill and infinite patience. At first he would hold their mouths open, pour into them diluted evaporated cream mixed with small bits of fish and then, holding the seal up by the head shake the food down. In this way some of the food reached their stomachs and the seals got the taste of food. Then he would tie a small piece of fresh fish on the end of a string and tease the seal by dangling it in front of its nose until the seal snapped at it when it would be poked down the throat and the string cut.

By the first week in November both seals were eating greedily. When the *Bear* arrived at San Diego late in the fall and the commanding officer, Capt. E. P. Bertholf, reported to Washington that the *Bear* had two fur-seal pups on board and in good condition, steps were at once taken by the Hon. George M. Bowers, Commissioner of Fisheries, to have them brought to Washington. All necessary details were soon arranged and Boatswain Thurber arrived in Washington January 11, 1910, with his precious pets. They were hurried from the express car to the Bureau of Fisheries where they were received with great interest; for no one at Washington except the few fortunate ones who had visited the Pribilof Islands had ever seen a live fur-seal. They were at once placed in the large pool at the Bureau after being photographed, measured and weighed. This pool contained fresh water and the effect upon the seals was awaited with interest. If they showed any distress it was arranged to supply them with salt water. But the fresh water did not appear to worry them in the least and they have been kept in it continuously to the present time.

Although somewhat restless at first they soon quieted down and appeared perfectly at home. They are fed regularly twice a day on fresh fish which they take eagerly, each eating from 5 to 8 pounds daily. When they were first weighed (January 20), the male weighed 28 pounds and the female 19½. Since then they have been weighed regularly on the twentieth of each month. On October 20 they weighed 46½ and 34½ pounds respectively. This is a gain of 66 per cent for the male and 77 per cent for the female in nine months. Whether this is a normal growth no one really knows, for never before were any accurate observations made to determine just how much a fur-seal six months or fifteen months old ought to weigh. But those who are familiar with seal life on the Pribilof

Islands say that these two pups appear fully as large and fine in every way as those of the same age on the rookeries.

Not only have these two pups been kept in fresh water but the water in the summer was much warmer than any Alaska fur-seal was ever before called on to endure. In July the temperature of the water ran as high as 83° F., and the average for that month was 80°. But this high temperature apparently produced no evil results; indeed, the seals during July were not only as playful and active as usual but they actually ate more during that month than in any other.

They have proved the most interesting pets that have ever been kept in the aquarium at the Bureau of Fisheries. They are the most expert swimmers imaginable. Their favorite pastime is to swim rapidly around the large pool in which they are kept, sometimes as rapidly as the most rapidly flying bird, often jumping like porpoises and splashing water on unsuspecting visitors. They circle about the pool. always turning to the right with the hands of the clock. Immediately after feeding they begin scratching and rubbing themselves, a sort of massage which doubtless aids digestion.

These fur-seal pups have now been kept in captivity more than a year. They have been kept in fresh water more than nine months. They are now sixteen months old and appear to be in excellent condition. The experiment has so far proved eminently satisfactory. It has demonstrated a number of very important facts. In the first place it has shown that fur-seal pups can be taught to take food when offered them by man. It also shows that they can be kept in captivity, carried long distances on vessels or railroad trains without any special difficulty, that they will live and thrive in fresh water, that a salt-water environment is not essential, and that they can live without any apparent discomfort in water of a much higher temperature than that of their natural habitat.

The success of this experiment also suggests a number of interesting possibilities. May it not be possible to save the hundreds or thousands of pups whose mothers are killed by the pelagic sea pirates every year? To do this it would be necessary to feed the pups only until the herd leaves the islands late in the fall. After they have once been taught to take solid food it would seem that they might be permitted to leave the islands with the rest of the pups and that their chances of survival in the sea would be quite as good as any.

The supplying of fur-seals to public aquariums and zoological parks is another possibility which seems entirely practicable. The possibility of establishing a colony of fur-seals in some fresh water lake is also suggested. The essential features would seem to be a lake with an adequate supply of fish, which does not freeze over entirely in winter and in which the seals would be fully protected.

But most interesting and important of all is the possibility of establishing colonies of fur-seals on our North Atlantic Coast. If the Canadian government could establish a fur-seal colony or rookery somewhere on her east coast, the pelagic sealing question would speedily be solved; for it would seem that Great Britain would at once join the United States and the other maritime nations in an international game law or agreement by which the High Seas beyond the three-mile zone would become a place of refuge for all marine mammals such as fur-seals, sea lions, walruses and whales. This would not only stop pelagic sealing but it would be the most effective step ever taken for the preservation of these rapidly disappearing animals. It is true that the difficulties in the way of establishing the fur-seal in the Atlantic are very great, but I do not think they cannot be met.

DISCUSSION

Mr. John E. Gunckel, Toledo: I would like to ask how high seals can leap or jump. In the city of Toledo in an aquarium we had two seals with, perhaps, the same history of the seals that you so ably described. One night the female seal managed to get out of an enclosure four feet high, over a fence nearly five feet high, and escaped to the river. She made her home at the mouth of the sewer where the carp were plentiful, and was finally caught. She escaped again, got out during the night time, was traced to the river, and got to Maumee Bay; and they will have to await my return to catch her. (Laughter.) It seems as though some one must have lifted the seal out of the aquarium tank.

Dr. Evermann: Those are not fur seals. They are a different species. They can jump quite high and can climb still higher. In order to keep our seals from getting out of their pool, we had to make the iron work about it curve inwards so they could not get over; they can climb very high and readily. How high they can jump I do not know.

Dr. C. H. Townsend, New York: We confined seals on the Seal Islands with a wire fence, but they would climb right over it; we could not hold any of them; they would go over it with the same ease that a boy would.

What Dr. Evermann had to say about keeping sea animals in fresh water is perfectly true. A couple of years ago we decided that the water of the harbor that we had been putting in the pools containing seals, sea lions, and manatees was too dirty. The animals got parasites; and so we put them in fresh water. They have been in fresh water ever since, and have been doing just as well and probably better than in salt water. We kept a sea-cow in the aquarium in the dirty water of the harbor two years and had the animal die of parasites in the liver. It is quite possible that the animal would have lived much longer if we had put it right into clear, fresh water. But that very foul harbor water will not be used any more with the animals. It is only used now in three or four tanks were it is impossible to put anything else. But if seals and sea lions die hereafter they will at least die in clear water.

Mr. Kelly Evans, Toronto: It may interest some of the commissioners where you have public game domains or preserves to know that the Ontario government has prohibited the taking of the beaver anywhere in the province for a period of years. The beaver increased in Algonquin Park to such a point that it was a positive nuisance, and it was recommended to the government by the commissioner of game and fisheries that the government adopt the principle of taking the beaver themselves by the rangers in charge of the park; that the pelts of these beavers should be cured, marked with the government stamp and sold at public auction. The government adopted the suggestion, and we have already taken the first kill, amounting to 500 skins. It is recommended (and I have reason to believe that the government may adopt the recommendation) that this practice be extended to all the other rivers in the province; and we believe that eventually the beaver may be made to support an important industry. The taking of beaver will be prohibited to everybody but the government agents, and it is thought a sufficient revenue may be obtained in this matter to provide for the upkeep of all the parks, and possibly go into greater figures and take care of the whole park system. You will at once see that there is no incentive to the ranger to clean out the whole colony. The idea in the proposition is to follow the German principle of taking the sustained yield only; and not only that but the beaver will be taken when they are in the very best condition; and further, it is thought that as they will bear the government stamp and as they will all be prime skins, gradually the prices in Germany and London will reach the highest figure for any beaver sold.

ADAPTIVE CHANGES OF COLOR AMONG FISHES

By F. B. Sumner

Perhaps I owe an apology for coming before this meeting with a discourse which bears so little relation to practical fisheries problems as this one on the color-changes of fishes. It is to be presumed, however, that the fish culturist and the angler have observed some of the phenomena which I am about to describe and have perhaps even realized in a general way their meaning. And I think you will agree with me that the man who takes an intelligent interest in his stock—be it fishes or cattle—is a far more practical man, in the broad sense of the word, than the man who confines himself to the ordinary routine duties of his profession.

That many fishes are strikingly adapted to their surrounding in respect to their general coloration is a fact familiar to all. A casual inspection of any good aquarium will reveal abundant instances. It has likewise long been known to naturalists that certain species possess the power of changing their colors with more or less rapidity in conformity to changes in the color or the shade of the background. Those, for example, who have had much to do with the common minnow, *Fundulus,* in our laboratories at Woods Hole, realize that this fish is far paler when kept in a white vessel than when kept in a dark one. The work of Pouchet and of a number of subsequent investigators has shown that the stimuli which call forth these changes are received through the eyes, since blinded fishes no longer respond adaptively. Such fishes may, it is true, undergo changes of color, but these changes have no relation to the optical properties of the environment. And, indeed, normal fishes may undergo rapid changes of color, as a result of what have been called "psychic" stimuli, *e.g.,* fright, sexual excitement, etc. Thus Dr. Townsend has recently published some interesting articles in which he has described and illustrated the color changes that he has observed among the fishes in the tanks of the New York Aquarium. And it is likely that most of the fish culturists present today have noted cases where a sudden and conspicuous change of color has resulted from a fish having been handled or otherwise disturbed. Such changes do not, however, have any adaptive significance so far as we know. They are probably of no more utility to the animal than are blushing and various other indications of emotional disturbance in ourselves.

It now seems to be fairly certain that the color changes of fishes are brought about by a movement of the pigment granules within the chromatophores or color cells of the skin, and not by an actual contraction and expansion of the chromatophores themselves. The work of Pouchet and others has shown that the efferent nerve tracts which control this action of the color cells pass through the sympathetic trunks. Section of the spinal cord alone will not result in a paralysis of the chromatophore function below this level; section of the sympathetic chain will do so. But just as muscle or gland cells may be called into activity by stimuli applied directly, without the intervention of nerve fibers, so the chromatophores may be caused to contract by tactile stimuli or by the electric current.

Such, in brief, are the main facts which have been recorded regarding the physiology of color changes among fishes. It is my purpose today to discuss certain experiments which I conducted at Naples * during the past winter and which I have continued during the present season at Woods Hole.

As is frequently the case with those who visit the Naples station for the purpose of biological investigation, I failed to find material suited to the problem upon which I had originally expected to work. I therefore said to myself: "So much the worse for your problem," and set about to

* I take pleasure in acknowledging the facilities and courtesies extended to me by the director and staff of the Naples station.

find another one. Now all of you who have visited the aquarium at Naples doubtless recall the tank devoted to flounders and other bottom-dwelling fishes. No one can fail to be impressed by the harmony of appearance between these fishes and their background, a harmony which relates not only to general color-tone, but to texture and pattern as well. (I will add that one need not go as far as Naples to see beautiful instances of this phenomenon. Our own aquarium in New York is provided with some good examples.) In viewing specimens of one of the common European turbots (*Rhombus maximus*) I was particularly struck by the detailed resemblance which obtained between the markings of the skin and the appearance of the surrounding gravel. Now, while the pattern of the fish was such as to harmonize wonderfully with this gravel, it would not, on the other hand, have harmonized particularly well with the fine sand, even if similarly colored, and would have been no better adapted to a bottom of large stones. The query at once suggested itself: is it a mere coincidence, this detailed agreement of the fish with its present background, or does the fish have the power of controlling the color-pattern as well as the general color-tone of the body as a whole?

Here, then, was a problem worth looking into. But, strange as it may seem, I found practically no references in the literature to adaptive changes in the color pattern of fishes. And, stranger yet, the possession of such a faculty —which soon become evident when I began my observations—was a source of surprise to others at the station, including one investigator who had carried on some important studies upon the color changes of crustacea and fishes. That this power exists I think will be plain to you from the lantern slides which I shall soon show you.

The fish from which I had the most favorable results was a small species of flounder (*Rhomboidichthys podas*) belonging to the Psettinæ or turbot group. Unfortunately this species is not at all as common as one would desire for experimental purposes, and during the latter part of my stay the supply gave out completely, so that certain important tests were left untouched.

When just brought into the laboratory by the collectors the fishes were usually of a rather dark brown color, with inconspicuous darker and lighter markings. This appearance makes it seem probable that they were commonly taken upon the mixed sand, composed of finely divided lava and tufa which is so common in the bay of Naples.

In my experiments, I began with natural backgrounds. I used the dark mixed sand just referred to; a fine gravel, composed of gray and brown pebbles of various shades; and again a coarse gravel, made up of stones an inch or more in diameter. I also used several other sorts of material, including a jet-black sand of almost pure magnetite crystals, and a white artificial product, obtained by grinding up marble. Bottoms of slate and of white opaque glass were employed in some of my experiments; and finally plates of glass which had been painted with various colors and with black and white, distributed in various patterns. It is with these last that I obtained some of the most picturesque results.

What these results were can best be told by reference to the lantern slide pictures, which I am going to show you, but it may be well at this point to sum up the leading facts which were revealed during my experiments.

(1) Fishes became nearly white upon a white background; dark brown and in some cases nearly black upon a black one.

(2) The animals were limited, however, to black, white, brown and gray tones.* Bright red or yellow back-

* More radical changes of color have, however, been described for certain other fishes, as, for example, one cyprinoid species, which has been found to vary from light green to dark brown, depending upon the condition of the bottom on which it lives; and our own cunner, when young, may be bright green, pink or of less showy colors. I do not think, however, that a transition from one color to the other has ever been observed in the latter case as a direct result of a change in the nature of the background, and the supposition that the same fish can undergo this change is only an inference.

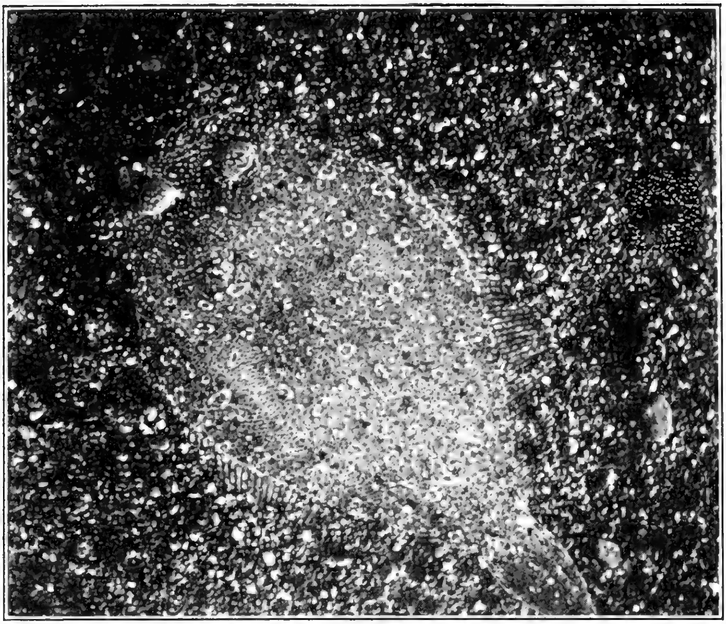

FIG. 1.—A Mediterranean flounder, *Rhomboidichthys podas*, showing color pattern displayed by the fish upon a bottom of coarse, dark sand, containing white particles.

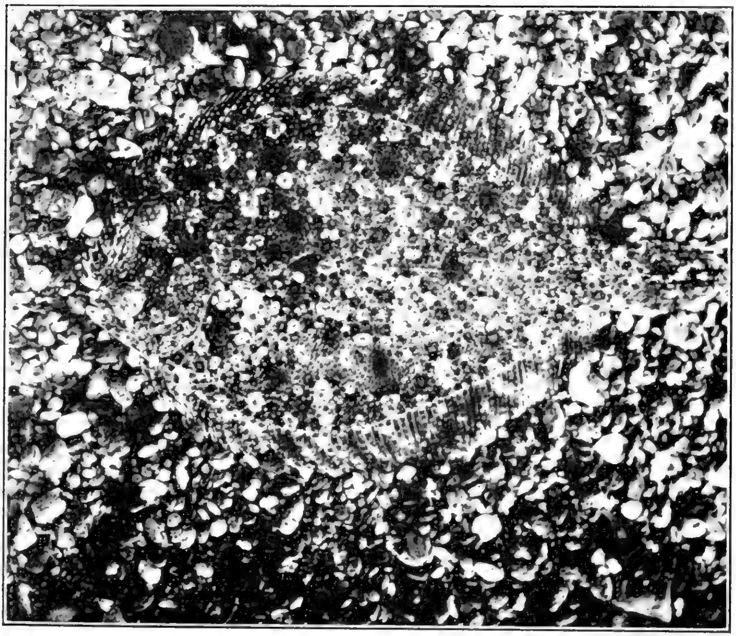

FIG. 2.—The same specimen as that shown in Fig. 1, after transfer to a bottom of fine gravel. (Compare carefully the markings in the two cases.)

grounds, for example, did not call forth adaptive responses. In other words, the pigments corresponded, in all cases, to components of the habitual background of the species, although it is true that shades were assumed which the fishes had probably never encountered in nature.

(3) Upon a homogeneous ground the visible pigment of the skin was commonly much more uniformly distributed than upon a background having a pronounced pattern.

(4) Upon a mixed background, such as was afforded by the ordinary sand or gravel of its customary habitat, the fish took on a definite pattern, which varied with the texture of the material.

(5) Experiments with painted squares and circles of black and white showed that the resulting skin patterns depended not only upon the *relative amounts* of black and white in the background, but upon the *degree of subdivision* of the areas of the latter. For example, when the background was divided into areas 2 mm. square, a finer grained appearance was produced in the fish than when 1 cm. squares were used.

(6) Artificial patterns of pure black and white gave far more contrast in the skin patterns than did the less contrasted tones of ordinary sand and gravel. Areas of almost pure black and white were in many cases displayed by the fishes.

(7) The various markings constituting these patterns were, however, found to be permanent in the sense they always reappeared in the same positions; and even when the animal adapted itself to a homogeneous background, and appeared to lose the pattern altogether, the outlines of most of these spots were still distinguishable. The arrangement of these blotches was, in its essentials, constant for all members of the species.

(8) The patterns assumed were consequently limited, in great degree, by fixed morphological conditions. Thus, squares, crossbands, circles, etc., were never copied, in any true sense, by the fishes.

(9) Within the limits thus imposed, however, the capacity of the fish to adapt itself in respect to the general proportions and distribution of pigment was often remarkable.

(10) This power of adaptation was best shown upon such backgrounds as formed a part of the natural habitat of the species. It was not, however, restricted to such cases, but the pigment was at times disposed in ways which, it is safe to say, were quite foreign to the previous experience of the race. For example, the nearly white, and perhaps also the nearly black conditions; likewise the vividly contrasted black-and-white condition, without intermediate shades, which was assumed by certain specimens upon some of the artificial backgrounds. Thus the notion that the fish is limited to a few stereotyped responses, representing the most familiar types of habitat, must be rejected at once.

(11) Fishes differed greatly in their individual powers of adaptation, and some seemingly normal specimens possessed this power in a very limited degree. Again, the same fish acquired with practice (if we may use the expression) the power of changing more rapidly than before. The time necessary for a radical change of shade or of pattern ranged from a few seconds to several days.

Some further experiments were tried, and are now being continued (though I am forced to employ a much less favorable object) with a view to determining the mode of operation of the stimulus which is effective in bringing about these chromatic changes. Some of the more important of these results we may sum up as follows:

(1) The animal depends upon sight for the performance of these adaptive responses. This, in fact, had already been proved and needed no corroboration. Indeed, it is impossible to see how adaptive changes of color *pattern* could be brought about by any other sense. If blinded when in the dark condition, the fishes remained dark, though they did not ordinarily retain the maximum degree of pigmentation; if blinded when pale, they remained pale for some

time, but reverted to a dark condition, representing more nearly the resting state of the chromatophores. An interesting special case, in which fishes turned pale immediately after blinding, will be shown in the lantern views.* Destruction of *one* eye commonly had little effect or none upon the power of adaptive color change. Indeed, one of the specimens which changed most rapidly and completely had been deprived of one eye. Tactile stimuli, if effective at all, are certainly quite subordinate, for the fish responded as promptly to patterns painted upon the under side of a sheet of glass as to bottoms of stones and gravel, whose complexity could be discerned by touch as well as sight.

(2) In the case of *Rhomboidichthys* the underlying surface appears to be the one chiefly effective in calling forth these changes. The vertical walls of the jar, when the latter were opaque, seemed to exert a subordinate influence, though I have pretty conclusive evidence that this influence was at times effective. What the fish saw directly overhead seemed, on the contrary, to exert a negligible influence upon the color pattern. (Experiment with spotted plate overhead.)

(3) In the case of our local sand-dab (*Lophopsetta maculata*)—a species related to *Rhomboidichthys*—the vertical walls of the receptacle exert a very pronounced effect, at least the lower portion of these walls, which is nearest to the eyes of the fish. I have performed experiments which seem to indicate that, with this fish at least, it is the total quantity of black and white surface seen—irrespective of whether vertical or horizontal—which determines whether the fish shall be dark or light.

(4) Finally, within very wide limits, the degree of illumination of the background has little or no effect upon

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* These were fishes which had been kept for a considerable period upon a white background, after which they had been returned to a dark background just long enough to cause them to become dark again.

the color tone assumed by the fish. A flounder placed in a black-bottomed dish becomes dark, whether in a dim corner of the room or in the full light of day. Conversely, a fish becomes very pale upon a white surface, whether this is brilliantly illuminated or heavily shaded. This fact has already been pointed out by other observers, and indeed it would seem to be a necessary state of affairs, in order that the coloration should be adaptive or cryptic. For it is obvious that the fish is shaded or illuminated equally with the surface on which it lies, so that the relation between the two remains unaffected by the degree of illumination.

A rather curious corollary may be drawn from this last principle. Suppose that we have two aquaria side by side, one with its inner surfaces painted white, the other painted a perfectly neutral gray. Suppose that the white aquarium is heavily shaded, so as to admit comparatively little light, while the gray aquarium is fully exposed to the light (indeed, a reflector was used in my experiments). Nevertheless, the fishes in the white tank should assume the minimum degree of pigmentation, while those in the gray tank should continue to display a certain amount of their dark pigment, depending upon the depth of the gray employed. Experiment shows that this is precisely what happens. The fishes in the shaded white tank become nearly white, those in the gray tank become gray. It is obvious, however, that the dimly-illuminated white walls of the one tank are actually *darker* than the brightly illuminated gray walls of the other tank, in the sense that the former reflect an absolutely smaller amount of light than the latter. (In my own experiments I have photographs showing this to be true.) An extremely interesting problem is involved here, which cannot, however, be discussed within the limits of the present paper.

A word in regard to the utility of this power of color change in the life of the organism. It is difficult to doubt either that this faculty has some use, or that it has been developed in some way because of its use. The end attained seems to be *concealment* and nothing else. No appeal to thermal regulation, to the possible "photo-receptive" power of the skin, nor to any other purely physiological explanation of the phenomenon seems adequate. A complete explanation must regard ecological factors as well. Whether the utility of these changes to the fish consists in their concealing the latter from its prey or from its enemies cannot, however, be stated without a greater familiarity with the bionomics of the animal than we possess.

I do not myself know what are the chief enemies of the flounders. Perhaps some of you may be able to tell me. I learn from Prof. Irving Field that he has taken flounders from the stomach of the goose-fish, but the latter had been caught in a fish trap and consequently had opportunities to gorge itself with other fishes which it would not have had in its ordinary life.* As to the prey of the flat-fishes, I can only state that the sand-dabs which I have used this summer were found to have eaten the sand-launce (*Ammodytes*) in large numbers. It may be, therefore, that their power of concealment is of advantage in enabling them to hide from smaller fishes until the latter come within dangerous proximity to them.

In regard to the lantern slides it must be stated that they do not represent occasional or exceptional instances. They represent appearances which were frequently observed, though not equally well in all fishes. Slides such as these fail to give an idea of the completeness of the adjustments, inasmuch as the colors are not reproduced, and the color resemblance between fish and background is often striking. The extremely pale condition resulting from a prolonged stay upon a white background cannot be reproduced by ordinary photographic processes, since the skin of the fish always retains a certain amount of yellow, and, as you well know, this looks disproportionately dark in a photograph.

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*Mr. Nichols, of the American Museum of Natural History, informs me that flounders are frequently taken from the stomach of the dusky shark.

Indeed, I have had to reject for this reason several of the lantern slides representing the appearance of the fishes upon white or pale gray backgrounds. And, finally, to properly appreciate these photographs one must compare them carefully side by side and not, as is necessarily the case with a lantern exhibition, in series.

(Twenty-two lantern slides were then shown).

DISCUSSION

Dr. C. H. Townsend, New York: I would like to ask Dr. Sumner if he found any instantaneous changes of coloration?

Dr. Sumner: I have observed changes which were almost instantaneous. Some of those fishes which had been changed back and forth a number of times and become habituated to making these changes, would change in a very few moments; and I have noticed that if you stir flounders and cause them to swim, spots will become visible which were invisible before, and vice versa.

Mr. E. N. Carter, St. Johnsbury, Vt.: Do fish that are blinded always become white?

Dr. Sumner: No, fish that are blinded in a dark condition will remain dark although not as dark as the maximum. Fish that are blinded when white remain white for a little while and then gradually turn dark.

The ones I showed which became pale immediately after blinding were so only because they had been on a pale background for some weeks and had become accustomed to that before being placed on a dark background. The dark condition is normal to this species.

Mr. Carter: Some years ago in passing by a pond I noticed a black bass gradually becoming darker. After several weeks the fish became almost coal black, and I then discovered it was blind. It was a small-mouth black bass.

Dr. Sumner: The dark color probably represents the normal resting condition of the color cells.

THE SPOONBILL FISHERY OF THE LOWER MISSISSIPPI*

By Louis Hussakof

The spoonbill is one of the most singular fishes found in American waters. It is often called paddlefish, in allusion to its extraordinary, long, paddle-shaped jaw. It is a large fish, often reaching a length of six feet and a weight of 160 pounds; and it is found nowheres else but in the lakes and rivers of central United States, ranging as far north as the Great Lakes.

From the name spoonbill cat, by which it is often known, one might think it a catfish; however, it is not a catfish. It is a ganoid, or a member of that ancient group of fishes which includes the sturgeon and a few related forms. The nearest living ally of the spoonbill is the *Psephurus,* which curiously, is found only in certain rivers of China. The paddlefish (*Polyodon*) and *Psephurus* constitute the family Polyodontidæ.

The paddlefish reaches its largest size and occurs in greatest abundance in the lakes connected with the lower Mississippi; and it was to one of these lakes—Moon Lake, Coahoma County, Mississippi—that Mr. Dwight Franklin, an artist-taxidermist, and the writer, went in quest of material for the preparation of an exhibition group of *Polyodon* in the American Museum of Natural History. Thanks to the many facilities extended to us by Mr. I. E. McGehee who carries on an extensive spoonbill fishery at Moon Lake, we succeeded beyond expectation. Mr. McGehee placed at our disposal his fishing paraphernalia and gave us every assistance possible in gathering *Polyodon* and the other ganoids found in Moon Lake.

Until about a decade ago the spoonbill was of little eco-

* Illustrated by lantern slides.

nomic value; it was interesting merely as a zoological curiosity. But about that time it was discovered that when smoked it makes a good substitute for sturgeon; and that spoonbill roe makes excellent caviar. Since then spoonbill fisheries have sprung up at various points on the Mississippi and Ohio Rivers.

The fish is usually taken in a seine. A practical method of operating a large seine has been introduced by Mr. McGehee at Moon Lake, and is worth noting. The seine is wound on a huge, spool-shaped reel which is mounted in a flat-bottomed boat. It is laid by unrolling from the reel; and is wound up by having the crew walk up the spokes of the wheels as on a ladder, so that the reel is made to revolve. As the seine is gradually wound up and the fish become confined to narrower and narrower space, they dart wildly about seeking means of escape. One may then study the paddlefish at very close range. Its sense of sight is poorly developed, as indeed one might infer from its small, beady, black eyes. If its "nose" is caught in the seine it makes only feeble efforts to free itself, and usually fails in doing so. The contrast between the clumsiness of the spoonbill and the alertness of an active fish is strikingly brought out if a gar pike is taken in the same haul; for the gar makes tremendous efforts to escape and unless rendered unconscious by a blow with a mallet, will flash through the seine as if it were gauze. Leaning over the side of the boat, near the corkline of the seine, one may seize a five-foot paddlefish by the "nose" or the tail and haul it into the boat; the only resistance is that of weight. The fish has absolutely no sport value.

The number of spoonbill taken in a single haul varies: sometimes only a few are brought up, and sometimes as many as a hundred. Of course other fish are caught at the same time—bass, carp, crappie, and drum; but they are only of secondary importance and the game fish thus taken are thrown back since they are safeguarded for the angler by state law.

Spoonbill fishery at Moon Lake, Miss., showing method of operating the reel in hauling the seine

Cutting up spoonbills and removing the roe, Moon Lake, Miss.

In cutting up the paddlefish the heads and fins are usually discarded, but sometimes they are boiled for their oil. The roe is then removed to be prepared into caviar. It weighs from two to twelve or fifteen pounds, in a single fish. It is put on a coarse wire sieve and rubbed by hand across the wires until the eggs are separated from their membranes and drop into the bucket beneath the sieve. The raw caviar is then mixed with " German " salt and is ready for shipment. It must undergo still further preparation, however, before it is in the form familiar to us. In its raw state it brings about half a dollar a pound. It is said that spoonbill caviar is the best known, having received the highest award at one of the world expositions.

DISCUSSION

Dr. B. W. Evermann, Washington, D. C.: I was very much interested in the paper on the spoonbill this morning and wish to say a word about that fish. One of the first spoonbill fisheries to develop in the country was that of Louisville, Ky., on the Ohio River. As long ago as 1898 I visited Louisville, where the fishermen were catching considerable numbers every spring. They had been catching various sorts of fish in the spring with seines which dragged the bottom of the river and did not fish at or near the surface, but they experimented and tried the use of seines which did not reach the bottom; but which fished the first five or ten feet from the surface down, and then they caught the spoonbill cat and the shovel-nosed sturgeon in very considerable numbers. They had been using the spoonbill cat then as food and using the eggs as caviar. The price then of the eggs was as high as 35 cents or 40 cents at Louisville and a higher price prevailed at New York. Of course, since then the price has gone on increasing until it is now quite as high as the price of the eggs of the lake or Atlantic sturgeon, which is $1.25 a pound—a very rapid and considerable increase in price.

The queerest thing about the spoonbill is this, that no one has been able to locate definitely its spawning grounds and to find the young fry. Spoonbills five or six inches long are about as small as anyone has ever reported. I think the smallest I have ever seen were eight inches; but fish five or six inches long have been reported.

That is one of the most important and interesting problems to be undertaken. It has been attacked by several embryologists and others, that is, to work out the life history of the young spoonbill; and some stations, such as the one mentioned this morning by the speaker, down on the Mississippi River would be, it would seem, the most promising places at which to investigate.

Another important locality for the spoonbill fishery is in Lake Pepin on the upper Mississippi. Considerable numbers are caught there every year, and search has been made for the fry, but no one has been able to find them.

METHODS IN AQUATIC PHOTOGRAPHY

By William Alanson Bryan

During the past year I have spent considerable time in putting into final shape certain material I have long been gathering for a popular natural history of the Hawaiian Islands. The preparing of suitable original illustrations had to be taken up at such odd times as various other duties would permit.

The working out of my problem, alone and in the middle of the Pacific Ocean, without so much as the aid of a single printed page on the subject of nature photography, resulted in the gaining of much valuable experience on one hand and the waste of no small amount of good photographic material on the other. However, my isolation made it not only possible but necessary for me to rediscover for myself much that others may have previously found out, but in doing so I developed certain methods and apparatus on independent lines that appear not to have been in common use. Some of these especially in the field of aquatic photography have proved so useful to me in my work that I venture to describe them somewhat briefly, thinking the results of my experiences may be useful to other naturalists who, similarly situated, may be struggling with their own problem of original photographic illustration.

One of the things to which considerable thought was given in my work was the developing of a plan that would give the largest number of illustrations at the least possible expense in the subsequent printing and half-toning. Economy made the use of plates when possible seem most desirable. Owing to the variety of subjects treated in the letterpress, their adoption in this case, in many instances, made it necessary to combine a variety of subjects on a single plate.

After considerable experimenting the plan of mounting objects as shown (in lantern slide) was found to be satisfactory for such specimens as could be photographed readily in the air by ordinary methods. I first secured a large sheet of the best quality double strength window glass. By breaking the large end of a small three-cornered file in such a way as to form a sharp cutting corner, a tool can be made which when fastened into a small hand drill makes it possible to bore any number of holes into the glass that may be required. To drill a hole, scratch the surface of the glass slightly at the desired place with the file point, then lay a small round lump of putty or soap as large as a thimble on the table beneath the scratch on the sheet of glass and with the file-drill proceed carefully to burr out a hole on the upper surface of the glass. When half way through turn the glass over and drill from the opposite side until the holes meet. The opening thus formed is then easily enlarged by carefully rasping it out with the spike on the small end of the file. With two or three holes close together, it is obviously easy to firmly fasten with a cord or by other means a variety of large objects to the glass.

The glass when stood upright in a grooved pedestal forms a transparent supporting screen through which the light as well as the shadow of the object to be photographed will readily pass. By locating the camera, the object to be photographed, and the background between two windows as shown (slide), it is possible to secure a photograph of any object held on the glass screen in the way just shown that will be entirely free from the undesirable and confusing shadows that the object would cast if placed directly in front of an opaque background.

The next improvement in the use of the screen was the discovery that a number of objects could be attached to the glass screen in any desired arrangement without injuring the specimen by simply sticking them in place with a few drops of hot paraffine. In this way, for example, plates with a number of heavy lava specimens were prepared, the single specimen sometimes weighing a pound or more. By the combination of holes and paraffine it is possible to "lay out" a specimen in a natural position on the glass, on the work table, and to know that it will stay in place while an exposure is made.

The next step in the improvement of the glass screen was the use of rubber sucking disks with wire pins attached, such as are used by window trimmers and others. The disks if moistened adhere to the glass with sufficient firmness to admit the impaling of specimens of considerable size and weight on the sharp wire points. The specimen is attached in such a way as to hide the sucking disks from view. The disks, while adhering firmly, at the same time admit of the readjustment or rearrangement of the object to be photographed on the screen, which in many cases makes the disk method to be preferred over the two methods of attachment just described.

The success met with by the use of the vertical glass screen in photographing dry objects in the air naturally led to the application of the apparatus and the principle involved to the producing of shadowless pictures of various forms of aquatic life. All that was necessary was to provide a fair sized aquarium—under ordinary conditions the best dimensions would be twenty inches high, twenty-four inches long, and twelve inches between the back and front. The two sides must be of good quality, very heavy plate glass. The ordinary battery jar will not be satisfactory as it is pressed into its form and as a result all the surfaces are rough and irregular. The irregularities of the surface cause curious refractions that give no end of trouble to the photographer. For the ends and bottom of the aquarium wood is to be preferred; it can be left its natural color or painted white if desired.

With the camera, aquarium, and background arranged with reference to the light as shown (in slide), the operator arranges his specimens, for example, three or four freshly-caught fish, by impaling them on the pins of the sucking disks, and carefully transfers the glass screen with the specimens in place to the aquarium. The glass is held vertically by slipping its edges into grooves at the sides and bottom arranged to receive it. The operator may expand the fins if desired and hold them in place with insect pins which may easily be concealed from the eye of the camera. It will be found that the buoyancy of the water will hold the specimen out from the glass screen in a natural position. The water, too, will take up any body juices that would run out to stain the background or to otherwise annoy the operator at the critical moment.

Care must be taken to have the glass sides of the aquarium both dry and clean, for a drop of water or a finger mark may ruin an otherwise perfect negative. By examining the illustration, it will be seen that the light is admitted into the studio through windows at the right and left of the camera, the dotted lines indicating the direction taken by the light reflected from the glass front of the aquarium. The light which falls upon the object to be photographed is sent back into the camera, while the shadows which the object casts are diffused by the light which passes behind it and strikes on the background.

The background should never be of a dark color. Black makes the glass aquarium front reflect light like a mirror. White, light grey, or even brown, may be used to advantage, and the greater the distance between the object and the background the better. When using glass aquaria or mounting screens, it is advisable for the operator to wear dark clothes, otherwise after satisfying himself that the image on the ground glass is free from reflections, the light from a white apron at the moment of exposing the plate may result in the securing of undesired reflections, that show plainly when the plate is developed.

A large number of satisfactory negatives of a great variety of marine forms were taken by this method. Some of them, as certain shells, were photographed in the air and again in water. The experiment proved conclusively in each case that certain obscure markings that did not show in the ordinary plate were brought out beautifully clear when photographed in the water. I found little difficulty in getting a fairly clear negative of certain crabs when photographed through eighteen inches of water.

My success with aquaria photographs encouraged me to believe that by applying the same principles, photographs might be secured in the shallow water on the coral reefs about the Hawaiian Islands that would be at least interesting and possibly of value in showing, especially the ecological relation of marine life to its environment. I was particularly ambitious to secure pictures of the large reef-building corals on the Hawaiian reefs. After much experimentation the apparatus shown (in slide) was designed and made. It consisted of a copper water-box twelve inches square, by eighteen inches deep, in the bottom of which was securely fastened, water tight, a square of plate glass. A thin board was made to slide into keepers on one side of the water-box and to this board, which projected a foot or more above the open end of the box, the camera was secured by the use of the ordinary butterfly screw. About the upper edge of the box the copper was turned back in such a way as to form a flange over which common black oilcloth could be tied to form a fairly water-tight joint. On the back of the can a handle was provided that served in carrying and steadying the instrument when in use. Two short legs were rigidly attached to the back of the copper water-box that projected from right and left at such angles as to keep the feet out of the field of vision when the camera was focused on objects on the bottom. In use the box was carried about by the handles, the black oilcloth being drawn up about the camera to protect it from the splash of the waves and to shut off the direct light from the plate glass, which was kept beneath the water. In this way the same condition with reference to lighting was secured as though the whole instrument, operator and all, were beneath the surface of the sea. That is to say, the light that entered the camera was that refracted from the objects to be photographed, and was free from that light reflected from intervening surfaces which would fog the image on the plate if the camera was focused on an object beneath the surface of the water. It may be explained at this point that the attempts to photograph submerged bodies in the ordinary manner, with the lens exposed, have usually resulted in failure because the exposure is made through the surface contact of two media, water and air, of very different refractive power. If the surface of the water is not perfectly smooth, as it is through the aquarium side or through the glass in the bottom of the water-box, the curving, rippling, irregular surface acts as a myriad of convex and concave mirrors that magnify, or reduce, or diffuse the image on the plate. Even when the surface of the water is perfectly smooth, unless precautions are taken to cut off the direct light as shown in the arrangement of the camera and the windows, the rays of light that come from the object beneath the water enter the camera at the same time with those that come from the glass side of the aquarium, or the reflecting surface of the water, in a way to destroy the clearness of the image.

The use of this apparatus was necessarily limited and its object largely experimental. It is difficult to work on the edge of the coral reef with such a clumsy apparatus, as the waves break over them, even on a calm day. But the trouble caused by the turbidity of the water, resulting from the stirring up of the sand as the operator moved about, or the waving motion of the marine plants as currents of water pass through them, is little short of maddening. Add to all the foregoing sources of annoyance the difficulty of balancing yourself, keeping the black cloth over your head, steadying the instrument against the movement of the water while focusing the camera, keeping the water-box glass dry and making the exposure, and you will have in mind a few of the multitude of little things that cause many failures, before even a recognizable picture can be secured of the life on the edge of a coral reef. I am free to confess that while I secured several plates that were fair, considering everything, I did not secure one that was satisfactory; and I doubt if there has ever been taken a really satisfactory submarine photograph.

My work in this line was highly interesting, very instructive, and, to be honest, very expensive, when measured in tangible results. The physical limitations are such that I doubt if this class of photography will ever become more than a spectacular achievement, the results of which will have but little real scientific value. In the first place the turbidity of the clearest water is such that any object beyond ten or a dozen feet from the camera is beyond the range of sharp definition, even though the object be fixed, while moving plants and animals are little more than blurred outlines. In the second place, the animals of the ocean are very shy and retiring, and it is slow and unprofitable labor trying to coax them, with some such dainty morsel as crushed shellfish or sea urchin as decoy, to come out of hiding and sit for their pictures, leaving out of account the trouble it takes to make the sitter smile and look pleasant while the exposure is being made.

A third difficulty is that the light at moderate depth is materially reduced. Even on clear, still days, under favorable conditions, it is difficult to secure enough light to admit making of short, not to mention instantaneous, exposures. Nevertheless my experiments on the reef at Honolulu were temporarily abandoned, not from discouragement with the work or the results secured, but from a conviction that I knew how to build a better type of submarine camera than the one I was using. The building of it, however, would necessitate considerable expense, including, among other things, the purchasing of a new specially equipped grafflex camera.

There is here shown (slide) a drawing of the plan on which the new camera would be constructed. A water-glass caison of suitable length and diameter would be made of galvanized sheet metal, substantially as indicated by the diagram. In the lower end a mirror would be placed at an angle of 45 degrees with the long axis of the caison. In the front of the lower end would be placed a window made of inch thick plate glass, to withstand the pressure of the water and to add weight at the proper place. Beneath the caison, which is perfectly water-tight, enough weight would be attached to sink the camera-water-glass-caison until it would rest lightly on the bottom. In the upper end I would mount a grafflex camera provided with a long focus lens and an automatic plate-shifting device and magazine to carry at least half a dozen plates. The device would, of course, give but a limited photographic field, but would be simple in plan and should demonstrate whether or not the theory was workable. If it should yield encouraging results, I would attempt a still further improvement by placing the plate glass window horizontally in the caison, above the mirror, and arrange specially ground lenses in front of the mirror so that both would be bathed in the water and would bring into focus on the mirror a larger field which would be sent by it through the plate glass window into the eye of the camera. Should it then develop that the light on the bottom was insufficient for rapid exposure, I would add to the equipment a specially designed flashlight gun. It would be a stout, square, water-tight box with a door in one side and a plate glass window in the front. From the top would extend a pipe to the open air, perhaps three inches in diameter, to allow the smoke to escape. The marine flashlight would be weighted to cause it to just rest on the bottom. The flash powder, held in a safety magazine, would be ignited when desired by blowing a jet of the powder over the small pilot light, the whole being operated from above the surface of the water.

Speculations such as the foregoing are opened here for the inventor, photographer, and physicist who may have the knowledge, interest, and funds with which to experiment in this interesting field, that lies just beyond the border line of what is known to be possible in aquatic photography.

But to return from theory to achievement. Enough was done with the camera water-box to prove that for scientific purposes its limits were such as to hardly warrant further experimentation in its then existing form. I returned with renewed interest to aquarium photography, with the belief that for all practical purposes one fish in a tank was worth a great many at large in the ocean when it came to securing photographs.

Having obtained satisfactory results in my work on still aquatic life mounted on glass screens, my next step was with a view to securing pictures of such interesting marine life as our tropical coral reefs afforded when they were alive and swimming about in the aquarium. Little by little, by patient experiment, I arrived at the methods which, if carefully followed, make it possible to photograph almost anything of reasonable size that lives in the sea, and, in most cases, to do so with an instantaneous exposure. The cutting down of the time factor made the motion picture possible, and I am very happy to be able to show you as a fitting conclusion to the paper, reporting as it does many months of experimentation, what I believe to be the first motion picture of tropical sea life that has been secured.

A word of explanation of the way in which the picture was taken will suffice after what has been said concerning the principle involved and the methods employed in aquatic photography. Light and yet more light on the object if properly managed is the key to success in this class of work. Experiments in the sunlight were satisfactory, experiments with white reflectors were better, and experiments on the sand by the seashore on a bright day were even more so.

I had constructed of redwood a large temporary aquarium three by five feet, with twelve inches between the plate glass, on the general lines before indicated. Since the weight of the water it contained was well over one thousand pounds and the empty tank was all four men could lift, the importance of mounting the aquarium upon a firm pedestal was well appreciated. A stout plank floor was built upon the sandy beach upon which was placed the pedestal mounted on trucks. This plan admitted of turning the aquarium at will so that it could be brought into nice adjustment from time to time as the changes in the light required. A large hood, eight feet on all dimensions, was then made of light poles and covered with tar paper which was nailed on and held firmly in place by an old fish net. A generous supply of fish was caught, the tank was filled with water, the camera was set up and tested, and everything was perfectly satisfactory. My assistant and I were busily engaged at a little distance attaching the sea moss to the large white sheet that was to be used as a background, and after the tank had stood full of water for a half hour at least, one of the plates of glass suddenly and without warning broke, deluging the dark hood, camera, and the seashore generally, and throwing the jagged fragments of glass for fifteen feet or more in all directions. Since accidents must happen, we were humbly thankful that we were at a safe distance when this one occurred.

Having mastered the principles, but being without a motion-picture camera, and satisfied that such a picture could be made, I joined forces at this juncture with my friend, Mr. R. K. Bonine, who had an excellent motion-picture equipment, and whose skill in its use is well known. I had a new tank constructed like the old one, except instead of 5/8-inch glass, inch plate glass was used for the sides, and incidentally I may say that six men were required to lift the finished aquarium into its place.

Judged by the results, I feel safe in saying that our equipment worked perfectly and the films and pictures are sufficient reward for the time, trouble, and expense involved in securing them. Naturally many interesting facts too numerous to detail here connected with the manipulation of the equipment were found during the course of our experiments. Worthy of special mention, however, was the fact that by reversing the usual procedure of photographing away from the source of light, excellent results were obtained by photographing from the dark hood, through the aquarium toward the light, when care was taken to use all available reflected light.

I have purposely omitted from this paper all reference to the practice of photography. There are many works dealing with the practical side. The wide field which photography now covers admits of accepting the ordinary practices as matters of common knowledge, and the foregoing purports to be nothing more than the development and perfection of certain methods, in a limited field, in which experimenters are few, which the speaker has found helpful; and he hopes the telling of his experience will be useful in one way or another to others.

THE AMERICAN MUSEUM'S EXHIBIT OF FISHES

By John Treadwell Nichols

I do not want to give a paper but just to say a few words to make you realize that we are interested in fishes here at the museum and that we are doing work in fishes. Of course, the primary work that a museum does is to make and take care of collections, and the collections which appeal most strongly to the mass of the people certainly are the exhibition collections.

Now dead fishes are very hard to exhibit properly. The aquarium has solved admirably the problem of exhibiting living fishes, and the museum is especially trying to show those things which one cannot see so well in the living fishes at the aquarium. We have so far found mounted skins very unsatisfactory. However well it is prepared, except in a few cases, you cannot get from a mounted skin a picture of the fish as it really is. It looks painted. We have found that models of many species give the idea better than mounted skins.

[Slide of a chinook salmon cast on exhibition.] This is a model of the chinook salmon which has been prepared for a number of years. We can now do better than that, but it gives an idea of what such a model is like.

[Slide of broad-sterned seine boats piled with seines, in tow of a launch.] This is a picture of catching the salmon. I was out in this region last summer. It is near the mouth of the Columbia River and shows a seining expedition starting off.

[Slide of a fish-wheel near Bonneville, Oregon.] This is one of the fish-wheels further up the river at the Cascades where the water is swift. These wheels are located so that the salmon may swim into them and be caught. It shows pretty well the principle of a fish-wheel placed at the edge of a river so that the fish following the shore, taking the easiest point at which to win against the current, swim into it. The wheel itself, like a big windmill, is turned round and round by the current of the river. You see two of its arms like the wings of a windmill. When one of these is directed perpendicularly downward the salmon swim into it. Each wing is a big scoop opening down stream and constructed of chicken wire on a frame, and as the wheel turns around, the scoop directed downward into which the fish has swum is carried forward and lifted out of the water as the current grips the next in order. Of course the fish are then rolled toward the hub of the wheel, where a slide takes them out into the fish-box.

[Slide of model of large cub shark being prepared for exhibition in the museum's laboratories.] This is a model of a shark captured last February at Key West. It measured about nine feet. Casts of it were taken at Key West by a scientific expedition undertaken in the interests of the museum by two of its members, and from the casts, after they had been brought to the museum, a model was prepared which you see here in process of preparation.

[Colored slide of a shark.] There is the shark on the beach at Key West. It is the cub shark, called blue shark at Key West. You seldom see it at the surface, but it is quite common in Key West harbor, and the small boys do not seem to mind it at all; they go in swimming just the same. I presume it feeds a good deal on carrion. We found a tin can in the stomach of one of them.

Although the blue shark is not dreaded, the tiger shark is very much dreaded in that locality, and I have also heard from the captain of a Ward liner who trades in those regions and occasionally brings us rare fish, that throughout the southern regions the tiger shark is very much dreaded. He tells of a case where hogs were being loaded on steamers by means of rafts, and these sharks tried to knock the men on the rafts overboard by bumping into the rafts.

[Slide of a swordfish model.] This is a swordfish being prepared at present in the museum.

[Slide of a mounted sailfish.] This is a fish we have on exhibition which was caught with rod and reel in Florida and presented to the museum. In form you will see it approaches the swordfish, from the more generalized mackerel type. It has the ventral fins while in the swordfish they are lost altogether; and the sword or spear is not as much developed as in the swordfish.

[Slide of an angler or goosefish and a skeleton of the same on exhibition in the museum.] Ordinarily the museum does not exhibit fish skeletons, but we have made an exception in the case of the goosefish. It is mostly mouth. In fact I have read somewhere that it has been called a specialized stomach subtending a large mouth. The structure of this fish is so very interesting that we exhibit a skeleton with the mounted specimen.

[Slide of a 14-foot sawfish cast.] Here is a sawfish taken in Florida last year which has been recently placed on exhibition in the museum.

Some little while ago we heard from one of the members of the museum that he had been catching sharks on the south shore of Long Island and wanted to know what kind of sharks they were. He was not satisfied with the information he could get from the literature, so I was sent down from the museum to try and solve this problem for him. It proved that he was harpooning the dusky shark (*Carcharhinus obscurus*.

[Slide of a dusky shark.] Here is one we harpooned that day. They come into the bay in the summer to bear their young, and are quite a common shark there. This one had inside it about twenty flatfishes, which it had caught on the bottom, and one or two fishes of other sorts. The gentleman who harpooned them said that they generally contained flatfishes.

[Slide of a sailboat with man aloft and man on bowsprit balancing harpoon.] Here is the boat from which he does the harpooning, and his harpoon.

A good many collections come to the museum to be identified and filed away in the study collection. By referring to that study collection we hope, when it has grown sufficiently, to be able to answer any questions about fishes which may be put to us. Of course, in gathering material like this for study, from time to time we discover new species. [Slide of a small blenny, *Stathmonotus tekla.*] This is one that has been obtained recently.

[Colored slide of a wreckfish.] This slide shows a fish obtained by the aquarium. This is very rare on our coast. It was identified as the European wreckfish (stone bass) and sent to the museum for storage. From time to time we are called upon to take care of rare fishes, secured in various ways.

DISCUSSION

Dr. Benjamin M. Briggs, Brooklyn: Could you inform us as to the possibility of utilizing the shark? We let the shark live and propagate; we lose the food the shark feeds on, the shark increases and our food fishes decrease through lack of the food appropriated by the shark. It eats good food always. It is not a scavenger. If anyone knows of any means of utilizing it, we would like the information.

Mr. Donald Nicoll, New York: I think that the Bureau of Fisheries has been doing some work to see how the shark could be utilized; but I do not know about that personally.

President: We should like to hear a word or two on that subject from Dr. Evermann.

Dr. B. W. Evermann, Washington, D. C.: Dr. I. A. Field, who had a paper before the Society yesterday, has experimented at Woods Hole for two or more seasons on the utilization of the dogfish, and has put them up in various forms. I do not know whether he is present; if so he could describe the work.

In brief it may be said that he put up the dogfish of both species in several very palatable forms, and there was, and perhaps still is in Nova Scotia a place where they are canning dogfish for the general market. The only difficulty now is to create a demand for that sort of food. There is no question about the edibility and palatability of it; the thing to overcome is popular prejudice.

Dr. Theodore Gill, Washington, D. C.: I can testify as to the edibility and palatability of the dogfish of both species. Under the name of dogfish are considered two very distinct kinds of fishes. The dogfish of the southern portion of the country, that is, south of Cape Cod, belongs to the same family as most of the sharks that are found along the littoral of the warm and temperate waters. The dogfish of the countries north of Cape Cod is of an entirely different species; it is the fish that is commonly known as the piked dogfish of England. Both of these I have tasted boiled, roasted, and broiled; and I have found them quite palatable, notwithstanding that the great majority of people cannot be taught to so consider them without urgent argument. I am afraid dogfish will not become vendible here for a long time. Nevertheless they are considered very palatable in other countries. The Chinese and Japanese consume large quantities of different kinds of shark; and they are even exported from California to China and Japan—especially to China. There are also fisheries on the Indian Coast where a shark is obtained nearly 60 feet long, it is said, and that fishery at least pays enough for the Indians, but the traffic has not extended to the Europeans.

Dr. G. W. Field, Boston, Mass.: The commissioners in Massachusetts have had some experience with dogfish in commercial ways other than food. The most recent experiments are upon the line of the utilization of the eggs. As perhaps you know, the eggs are about the size of a hen's egg, and we found they could be used to replace hen's eggs for currying leather. But dogfish eggs cannot be procured in commercial quantities at present on account of the prejudices of fishermen, who object to handling the fish; they simply get rid of them as quickly as possible. If those fish could be utilized in large quantities, where the liver could be used for oil and the eggs for currying leather, the skin possibly tanned for glove leather and for sword belts and things of that kind, and the body itself used either for food or fertilizer, there is no question but that dogfish could be utilized to a very great advantage directly as food.

Indirectly also it could be utilized for the benefit of other fisheries by removing from the sea an animal which lives entirely or almost entirely upon edible fish, and which is practically levying a toll upon the fisheries of the United States and of the world to an extent which is inconceivable. We have found by inquiry among the fishermen of Massachusetts alone that their catch of dogfish is practically equal to all other varieties of edible fish. We found that their estimate was that they caught 27,000,000 dogfish in a season, and I am assuming that the dogfish weighs from three to five pounds. That practically foots up to the cod catch. It is really an enormous problem.

Dr. Gill: What is a dogfish? A dogfish simply means, in popular parlance, a small shark that lives in large droves or schools; but in the case of the southern dogfish, it is one that has the form of most of the temperate and tropical sharks, without the spines to the fins. It has a well distinguished anal fin. The species of the north is entirely different; that is, it has a spine in front of each dorsal fin, and it has no anal fin. The teeth are extremely different in the two. But these are only superficial differences. When you come to examine the skeleton you will find that the differences are vast. Morphologically speaking, the term "dogfish" has no meaning. It is simply then, as I repeat, the designation of a small shark living in large communities.

Mr. Charles R. Knight: I have just come back from Woods Hole where I have been observing dogfish and sharks, and there the hound-like character of the dogfish was quite noticeable in its feeding. In a pool at Woods Hole they have quite a number of them. I would throw a fish in there at one end of the pool when the dogfish were at the other, and in a few minutes they would be attracted evidently by the smell of the fish, without seeing it, and would come around it just like hounds scenting their prey; that is, by running their noses back and forth until they touched the fish, and then they would seize it. That is different from the characteristic of the sand-shark and others, which simply come around singly and bore their noses into the sand in the region of the dead fish wthout seeming able to see it. But I think this curious hound-like characteristic of scenting their prey was rather indicative of the dogfish.

Another thing: Mr. Nichols perhaps did not make quite clear the difference between a mounted shark or a cast of a shark and the one that he showed of the cub shark being prepared in the museum. Now that is modeled by a sculptor, one of the men employed here, modeled by hand and put into a correct and lifelike position which it is practically impossible to get by simply laying down a large or small fish and casting it; and I think anybody who looks at that specimen as finished will realize that difference. In that case the living character has been copied. There is an extremely graceful turn of the body characteristic of all the sharks which is shown in a way that I think has never been indicated before, and which it is quite impossible to show, as I say, in simply casting it from the dead fish. I think it shows rather a departure in the line of exhibition of large fishes. If you can get a man who is artistic enough to copy the character accurately, then by all means have it done that way in preference to the ordinary cast.

Mr. R. W. Miner, New York City: I think that in connection with this address of Mr. Nichols perhaps one phase of his exhibit of fishes in the American Museum was not quite fully dealt with.

Of course the primary purpose of an exhibition in this museum as a public institution is that it should be educational in character. We have our collections here arranged in as scientific a manner as possible for the use of specialists who desire to investigate particular groups; these we have in the past placed in convenient storage cases, so that they can be readily taken out and handled by specialists. But for the exhibition halls there is quite another point of view. We owe a duty to the public of this city from whom we receive a great deal of our support; and that duty is one of education. Our exhibits are not only for the public at large who may wander into our halls, but also for the children of that public who are brought up in our schools and in contact with natural science in an elementary form through the teachers of the public schools. It is to them, of course, that we look in the future for the development of a good many of these questions that touch most nearly our economic problems. I believe, in common with the rest of the scientific staff of the museum, that the development of an interest in the problems connected with our natural history, in the principal problems of the fisheries, for an immediate example, is what may be considered our immediate duty to the rising generation. And, therefore, instead of presenting long lines of exhibition cases with alcoholic specimens in them, we have tried in the past to present our exhibits in an attractive form and from the point of view of the course of study in the schools; so that teachers may impress upon their pupils those lessons which it is most desirable to impress, and particularly connected with those economic problems that it is our duty and our pleasure to solve.

It is necessary, therefore, to make selections from our scientific collections; not only that, but to substitute for the shrunken and bleached material which we ordinarily find in alcohol—for the dried specimens which are sometimes exhibited in a shrunken condition for the larger fishes—the lifelike representation of the actual fish; to teach these elementary students facts which will not be distorted through methods of preparation.

Therefore we have taken, in the case of the fishes, casts and models and plates which will represent fish more accurately than it is possible to do with the alcoholic specimens, and then those have been arranged with a labeling which it is intended shall appeal to two different sets of people—in the first place to the elementary students of the public school and in the next place to the more advanced of the morphological and biological students who come to us from our universities.

THE NATURAL HISTORY OF THE WEAKFISH

By Theodore Gill

Mr. President and Gentlemen of the Society: I did not anticipate being called upon this afternoon, and, consequently, I did not come prepared with my paper, but I will give orally the essentials of what I have written.

Every once in a while I receive a letter asking what is the weakfish; every once in a while in Washington I am appealed to orally to know what the trout is. It is only a few weeks since a lady wrote me saying that her family had a country place in Maryland which they occupied during the summer, and that they could get no fish but so-called trout; she knew what a trout was very well and knew that the fish which they called trout and which sold as trout was not a true trout; and she asked me what it was. I told her. Now the so-called trout of the Southern States and of the Atlantic States from Pennsylvania southward, is not at all related to the true trout, but is a member of an entirely distinct family and even a distinct primary division or order.

Our nomenclature of fishes generally is a very mixed one, and several different modes have been adopted in framing and applying popular names. One (and the most natural one) is to name the fish after that which is—or is supposed to be—most like it. That was the plan adopted especially in the New England States. When the pilgrims proceeded to New England they found a number of fishes which they thought were like the ones they knew at home, and, consequently, they applied the names familiar to them, and misapplied many of them. Many of the names, of course, did fit, such as the trout, codfish, and several others. Naturally they applied because the American fishes were almost the same as, or at least, very closely related to, the fish of England. The trout of our northern waters, indeed, belongs to a different genus of fish from the English trout; nevertheless, it is so nearly like that it was quite reasonable to name it as such; but when we go southward, the case is very different. The trout of that section, I repeat, is by no means the same as the trout of New England nor that of old England. Such is the first method.

A second method is to apply some name distinctive of quality. The method has been followed in the case of the common fish called in New York the weakfish. Inasmuch as that name is used by a population numbering in round numbers 6,000,000, or nearer 7,000,000 now—that is, in the city of New York and in the immediate vicinity, New Jersey and Long Island—weakfish is the name in most general use.

A third mode of nomenclature is manifest to a more limited extent. It is exemplified by squeteague, supposed to be of Indian derivation and formerly used, it has been claimed, by the Indians of Narragansett Bay, but there is not complete justification for that belief. The derivation appears plausible, but J. Hammond Trumbull, an authority of first rank on Indian philology, was unable to find any instance of the word as an Indian name in any book that he examined. So, therefore, we do not positively know what the origin is. The name squeteague, nevertheless, is at present in most general literary use. It was declared by Goode and others, for example, that squeteague was the best term applicable; consequently, it has been accepted in most of the books on fishes and has been quite generally adopted.

The name "trout" is used universally in the southern Atlantic States, and is practically the only name known there.

Now as to the reasons for these names: "Weakfish" you will find given in sporting books, in the Century Dictionary, and other works, as meaning weak in the mouth. That is, it was apparently applied to the fish because it had a weak mouth, and consequently could not be held by the hook as well as most fishes.

Another author of very recent date (last August), in one of the sporting papers, contends that "weakfish" was simply derived from "squeteague" by a series of changes, euphonic and otherwise, which I will leave to your imagination.

Another author has said that it was not originally "weakfish," but "wheatfish," and that "weakfish" is a corruption of "wheatfish." As W. H. Herbert says, however, it does not come in the wheat season but in the early spring.

Now, then, what *is* the derivation of the word "weakfish?" The explanation, after all, is very simple. "Weakfish" is a heritage from our Dutch ancestors of the island of Manhattan, of the New Netherlands. They gave the name "week-vis," and that name was adopted by one Steendam in a poem in praise of the New Netherlands. The poem was published about 1661. There the word is used in the form "week-vis." That is very much like our English word, but "week" does not mean the same thing in Dutch as "weak" in England. "Week" in Dutch means primarily soft or tender. The word "weakfish" indicates, then, a soft and tender fish, and everyone acquainted with the fish will recognize that the term is quite applicable. The name is very easy to trace to its original source, and it is strange it has not been traced before. Nevertheless in the latest dictionaries it is given as "weak" and "fish;" but it is really derived from Dutch, as just explained.

The name "squeteague" is perhaps of Indian origin. Its original use is not known; it does not occur in the earlier works.

The name "trout" was given by the original settlers of Roanoke, Jamestown, etc., and is the one generally used in the south. The common weakfish of the south is spotted somewhat like a trout and as no true trout occurred in the south to compare it with, trout was the name applied to it.

Now this trout of the south, this weakfish of New York, is one of the most valuable fishes that we have on our Atlantic Coast. It belongs to the family of sciænids, which furnishes in the south more than half of the total catch of fishes for edible purposes along that coast, and the weakfish furnishes more than half of the total number of sciænids. So it is a very important article of food.

I have used the word weakfish in the singular as a generic term. There are really two very distinct species. There is some distinction as to the value of the weakfish of the north and south—that is, the flesh of the weakfish of the south does not seem to be quite as soft nor quite as loosely constructed as that of the north. The southern fish is, therefore, a better one than the northern.

Now to furnish some of the characters. The family of Sciænids is one of the most important of all the families of fishes. It is a very natural family exhibiting a number of osteological characters in common, but they would be too technical to speak of—so I will simply allude to a few.

There are a number of foramina in the upper surface of the skull which furnish exits for blood-vessels and nerves. Such are some of the characters that strike the observer of the skeleton. If you will look at the mouth you will find also a number of characteristics that strike the attention forcibly. There are a number of lobelets and holes along the edge of the head next to the jaws and mouth, but the weakfishes rather differ from others of the family in that they are reduced to the minimum.

The other characteristics are too technical to enter into. I will only state that the natural associates of the family of sciænid fishes are numerous. About twenty species have been recognized and these twenty are all confined to America, north and south. The species are almost entirely tropical and warm-water forms. The weakfish of our northern waters, the common weakfish of New York, is the most northern of all of them.

With respect to the size: probably you have little idea as to the diversity of opinion and the diversity of statements in books as to the size of the weakfish. The average seems to be somewhere over two pounds. In Massachusetts and Rhode Island much larger ones are caught. Apparently the southern species becomes larger than the northern, so that from two to three pounds is the most correct statement. Sometimes a school of the northern weakfish may be composed of fishes not more than three-quarters of a pound in weight. I now quote Baird who wrote in 1854.

The maximum is difficult to state. As you are aware, there is no definite limit in growth among fishes as there is in warm-blooded animals—birds and mammals.

In some of the statements in the books you will find that the weakfish is put down as attaining a maximum of 30 pounds. Now it is possible that occasionally a weakfish may attain that weight, but I never have seen an authentic case mentioned. The heaviest weakfish that we have authentic information about is one weighing 17½ pounds. The next largest that I know of weighed 14. Many observers who testified in Rhode Island said that the largest they ever knew was under 10; one witness said 9 and another 8. So that although a maximum of 30 pounds is conceivable, it is not probable. We can in fine put the average weight as somewhat over 2 pounds. That I think will be a fair average for the north; it is considerably larger in the south.

The age at which maturity is reached is another question concerning which there are differences of statement. It has been recorded that the weakfish attains its full growth in a year—that is, that a fish that was last year hatched from the egg will mature the present year. That seems to have been based upon the rapidity of growth of the young in the first two months, but I do not think that it will stand the test of observation. More correct probably is the inference that it takes generally nearly three years to mature, that it is only the weakfish of the third year after its escape from the egg that is ready to propagate.

Now I am fearful of going too much into detail and technicalities, and therefore I think I will stop and be ready to answer any questions that may be asked. The fuller details and a resumé of what is known of the habits of the species will be published later.

DISCUSSION

PRESIDENT: The doctor's explanation of how this fish came to be named "weakfish" was very clear, but from the standpoint of the angler these fish I understand are anything but weak. I never caught one of them, but I am informed that such are the facts of the case.

MR. W. E. MEEHAN, Harrisburg, Pa.: It seems to me that Dr. Gill's estimate of 2 pounds is rather light, at least, for the fish along the Jersey coast and in Florida waters, where I fished for many years. I have caught many weakfish in the Homosassee River, and the average was certainly 3 pounds or more. Fish of 5, 6, 7, and 8 pounds on that river were not uncommon. The heaviest fish I caught on that river was 12½ pounds, and I have caught several ranging from 10 to 12½ pounds. On the Jersey coast, in the bays like Barnegat and around there, the average weight is certainly low—possibly half a pound or three-quarters of a pound, one pound or a pound and a half—but when you get outside, off points like Longport near Atlantic City, where you get among what is commonly known as the tiderunners, the average weight seems to me to be beyond that. I should say an average of about 3 or 3½ pounds, with frequent fish weighing 4 and 5 pounds, and occasionally about 8 pounds. That was about the heaviest that I have caught on the Jersey coast. Dr. Gill's figures are so surprising, so different from what my own experience has been in the catching of this fish that I can hardly understand them.

MR. W. H. BOARDMAN, Central Falls, R. I.: I was surprised at the statement about the size of what we call the squeteague. It is sold to people that do not know much about it as a "bluefish." Of course it is not. Men accustomed to squeteague fishing say 3 pounds is small. I have seen many weakfish weighing 15 and 16 pounds, on the lower bay, especially around Wickford; 8 pounds and 10 pounds is the average weight of the fish; and from that they run up as high as 16 pounds. One day, with Mr. Willard, I went out with the Lewis Brothers and saw them pull one of their traps to show some visitors. I believe there was not a fish in that trap that was of the small size mentioned by the speaker. The small fish were running 8, 9 and 10 pounds, two or three weighing between 15 and 16 pounds. Of course, that is in the lower bay. If you ask anglers how they are running, they call 3 pound squeteague running small. That I know is true with reference to Narragansett Bay; and 5, 6, or 7 pounds is running fair. I have known of fish being caught above Providence Point weighing 13 pounds. Below Providence Point they commence to get larger until you get down to Fox Island, where the Lewis Brothers fish and they get the big ones. Off Nantucket they run 8 or 9 pounds. Fish in Greenwich Bay I have known in quantities weighing 2 pounds each on an average, but the boys do not consider them worth going after, although sometimes that is all you can get.

Dr. Gill: You have a sample here of the variety of opinion there is as to the weakfish. We have had the word "bluefish" as an additional difficulty. The term "bluefish" is misapplied along part of the New Jersey coast, as Mr. Meehan knows. The name "greenfish" is sometimes misapplied. The name "checouts" and variations of it have been applied along the eastern coast of Long Island.

Now as to the average weight. By average weight I mean the average weight of the numerous fishes found along the coast as well as those outside. It has been truly said that the average of the fish that are caught in the outside waters is greater than the general average, or than those that are found in the interior. It is very remarkable that so many fishes as large as 16 pounds have been obtained. In 1871 testimony was taken by the United States Fish Commissioner in Newport, R. I. A number of professional fishermen and owners of pounds testified there and their consensus was that the weight of the weakfish was about 3 or 4 pounds; that is the average maximum or maximum average.

Dr. Baird also made extensive observations on hauls on the coast of New Jersey in 1854 and found among many thousands that the average was a good deal under 5 pounds; so that the experience of anyone finding a number of fishes of 16 pounds weight must be somewhat exceptional. And as to Mr. Meehan's statements, they conflict with what was obtained by Professor Baird and fishermen generally.

I do not deny any of these statements. I am much interested in them; but in my estimates I have been guided by my own observations, and I have never seen in the markets a fish weighing more than 4 pounds. Among the many thousands that I have seen from my youth upward I never saw a weakfish that weighed much over 4 pounds. My observations of the fish in the New York markets commenced as far back as 1854, when I was a youth. I went through the markets daily then, that is Fulton Market and Washington Market, New York, the great fish markets. The weakfish were not then the predominant fish that they are now in New York, but, nevertheless, I saw countless thousands, and I do not recollect of having seen any that was much over 4 pounds. But I wish that that experience could be recorded so that it could be made use of in my article; 17 pounds, of course, is quite possible, I don't deny that at all.

Mr. Meehan: Twelve and a half pounds was the largest.

Dr. Gill: And you weighed them?

Mr. Meehan: Yes.

Mr. Boardman: I saw them weighed a year ago last July, and the fish were running rather high but nothing extraordinary.

Dr. Gill: As I stated at the outset, there is no such period of growth for fishes as there is for other animals; so that it is quite possible that there might have been an exceptional run of fishes do not think you could repeat it, and I think I may safely say that your weighing as much as that, but that must be entirely exceptional and I experience would not be repeated again if you lived to be as old as I am.

Dr. B. M. Briggs, Brooklyn: My experience is that this year they are running small, and some years ago they ran very large—10 to 12 pounds—off Sheepshead Bay. They appear to run of uniform size when they run in schools, but this year thy have been running small and the only way to tell is to take five to seven years and average them. Probably the large ones come in once in five or six years.

Dr. Gill: That remark is correct, that is, that they are associated together in schools in approximately the same size. Indeed many schools of fish do that. You will find a school of large and a school of small fish, and the average is that which may be derived from the consideration of the schools of one year in comparison with the schools of another; the average is very often exceeded.

Mr. Kenneth Fowler, New York: The experience in the wholesale fish trade of New York in regard to weakfish I think largely demonstrates that the smaller fish are caught in the coastwise waters, and that the large fish are almost entirely caught in the outside waters. The catch for New York market is made largely by fishing smacks and seining operations in practically the open waters of the ocean. Every year we have large catches of weakfish, 50,000 to 100,000 pounds, seined in the open ocean, and the fish will average from 5 to 7 pounds right through the catch.

Also it is a fact that the size of the weakfish differs in different years, and that has been amply demonstrated by experience in the trade back ten or fifteen years. But this year, notwithstanding the statement of the gentleman who has just preceded me, I think at least one-half of the catch of the weakfish by the seining fleet for the New York market has averaged at least 5 pounds. Our experiences further go to show that the run of particularly small fish comes on in the fall of the year, and that the large fish are caught almost entirely in the early months of the summer, June and July, running until the early part of August, with exceptional runs of large fish in the fall.

SOME OF THE DIFFICULTIES ENCOUNTERED IN COLLECTING PIKE-PERCH EGGS

By S. W. Downing

The conditions under which eggs of all species of fish are collected for propagation purposes have been steadily becoming more trying and difficult during the past ten or fifteen years. Especially is this true of the pike-perch and other fishes that deposit their eggs at the upper end of Lake Erie in the spring of the year.

For the better information of those not familiar with the method of collecting eggs for the Put-in Bay station, and in fact for nearly all the stations on the Great Lakes, it will be necessary to say that at these stations no brood fish are kept, neither does the Bureau do any fishing, but the eggs are secured from fish caught by commercial fishermen for market. The spawners go out in the boats with the fishermen when the latter go to lift their nets, or else the Bureau arranges with the fishermen to take the eggs themselves, paying a certain price per quart. In either case, however, the eggs must be taken and cared for out in the open lake.

The increased difficulty in collecting good eggs has been brought about chiefly by changes in the manner of capturing the fish and by the increased demand for getting the fish to market at the earliest possible moment after they are taken from the water. Ten or fifteen years ago the greater part of the fish caught at the head of Lake Erie were taken in pound nets, and but few of them were expected to be packed for shipping to the distant markets before the following day. There was consequently no such hurry and rush as exists today to get the nets lifted and the fish to the fish houses for packing.

The pound net as used ten or fifteen years since consisted of a leader, hearts, tunnel and the crib; the leader and hearts fishing from top to bottom, the bottom line being held down and in place by means of heavy anchor-stones which were tied to the line a few feet apart the whole length of the leader and hearts, and the top line held in place either by being tied to stakes driven for the purpose or by tin buoys especially made; the crib or pot which held the fish and from which they were taken when the nets were lifted, as the raising of the crib is called, was a square room with four sides and a bottom, and was from twenty-five to thirty feet square and a little deeper than the water in which it was set, so that the twine of the crib came about two feet above the surface. As the fish simply followed the leader into the hearts and from the hearts through the tunnel into the crib, it will be seen that they were not injured in the least, in fact not even frightened, and the ripe ones thus caught should, and undoubtedly did, yield their eggs to the spawner in just as good condition as if the fish had deposited them on the natural spawning beds.

Formerly, the fishermen used large roomy sailboats, called pound boats, for lifting their nets. In these boats there was ample room for the regular fishing crew to do their work and also for the spawner and for all the necessary utensils for his work. As it of a necessity required some time to lift one of these nets with a large unwieldy boat and set it again and then sail to the next pound, the spawner had plenty of time in which to overhaul all the fish, collect the eggs from the ripe ones and care for them by the time the next net was lifted.

Now, however, this is all changed. But very few pound nets are used, and but a very few of those that are used are lifted with the old style pound boats, most of the fishermen using what is called lifting boats, which are much smaller and are in most cases towed by a steam tug, the tug towing two lifting boats with a crew of men in each boat. Upon nearing the first pound one of these boats is loosened and goes to the net to lift it, while the tug goes on to the second net with the other boat. The tug then immediately circles back to the first boat, picks up this and tows it to the third net, continuing until the nets are all lifted, when the tug returns to the market with the day's catch of fish.

As the lifting boats described above are much smaller than the old style pound boat, are more easily and quickly handled around the net and are towed from one net to the other with the tug running at full speed, the men all working with the object of getting the nets lifted and the fish back to the packing house in the least possible time, it will be seen that the spawner has but a limited amount of time in which to do his work. He has also but small quarters in which to do it, and when it is remembered that he must overhaul the fish, select the ripe ones, secure the eggs, fertilize and care for them, and at the same time keep the eggs, spawn tools and himself out of the way of the fishermen, in order not to delay their work, it will be seen that even under these conditions, which are about the best that exist to day, the spawner has to work under difficulties. Especially is this true in rough weather, which we are likely to have during a great part of the spring and fall spawning seasons.

The above treats only of collecting eggs from fish caught in pound nets and under the more favorable conditions. At the present time but a very small part of the fish are taken in pound nets. The net most used is called a trap net, the general plan of which is much like the pound net, having a leader and hearts, tunnel and pot, but the crib or that part that holds the fish is much smaller, is entirely submerged and is held in place by anchors, no stakes being used. When raised it is hauled up on the stern of the boat and an opening made by unlacing the top, through which the fish are removed by the use of a long-handled scoop net.

In order to handle this kind of net more easily and quickly, much smaller boats are used than in handling the pound net. These boats range from sixteen to twenty-two feet long and from four to six feet wide, so that the spawner has still closer quarters to work in and less chance to keep spawn and apparatus out of the way of the fishing crew. At no time is a small boat as steady and convenient to work in as a larger one, and it will be seen that during rough weather the spawner who collects eggs from fish taken in trap nets does his work under extreme difficulties. As fully seventy-five per cent of the pike-perch eggs collected for the Put-in Bay station are secured from fish so caught, as the pike-perch eggs are among the most difficult to collect, manipulate and deliver to the station in good condition, and as fully one-half of the eggs brought to this station are collected in fields so remote that they have to be packed on trays and shipped from the field station in cases by rail and by boat, is it any wonder that from forty to fifty per cent of eyed eggs is all that the fish culturist can get out of the total take?

Nor does the trouble in handling pike-perch eggs end upon safe delivery at the station and setting up in the jars. It does not cease until the fry are all hatched and either deposited in the lake or turned over to the car crew for the troubles that may come then. In fact, we sometimes feel like speaking of the pike-perch eggs after the manner of the man in a controversy who after exhausting his stock of epithets, said to his opponent, "and if you can think of any mean thing that I haven't called you, you are that too."

DISCUSSION

PRESIDENT: We all know who have had any experience with pike perch, that they are among the most difficult fish to progagate that we have.

MR. S. F. FULLERTON, St. Paul, Minn.: I would like to ask Mr. Downing if that is not the closed season?

MR. F. N. CLARK, Northville, Mich.: I doubt whether Mr. Fullerton has the same laws we have in Michigan. During the spawning season of the pike perch, the whitefish, and the lake trout, the fishermen are allowed to fish, but they must take all the eggs, impregnate them and turn them over to the Bureau of Fisheries or the Michigan Fish Commission. That is the law there. It is not a closed season any further than that they cannot fish if they will not obey the law. On the whitefish and trout there is no closed season from July to the 20th of November.

Mr. Fullerton: Minnesota's law is that you cannot catch pike perch before the 1st of May, and spawning is generally over before that time. Any fisherman that wants to fish must do so under our direction and under the conditions imposed by the law.

Mr. Clark: Every state has its different law, and that is the trouble.

Mr. Fullerton: I have always said that.

Mr. Clark: If we ever arrive at a point where there is a law of uniform control by either the states or national government, then we will have one good law for all the lakes, which we have not today. For instance, under the Wisconsin law the fisherman gets a permit from the superintendent of fisheries and that permit can be given at any time the superintendent sees fit. This year I understand that where we are going to take eggs, he will give the fishermen permission to commence operations on the 20th of October.

President: For the benefit of those not familiar with pike perch eggs I will state that the same difficulties, and perhaps worse ones, are encountered in taking whitefish eggs, because they are collected in November, the stormiest month of the year; and yet we hatch 80 per cent to 90 per cent of whitefish, while the percentage of pike perch eggs is much smaller. The difference is that one is an adhesive and the other is a non-adhesive egg. So it does not follow that you can hatch 90 per cent of adhesive eggs because you can of non-adhesive ones any more than it follows that a grass widow is green.

PIKE-PERCH NOTES AND SUGGESTIONS

By W. O. Buck

In his valuable paper presented at the International Fisheries Congress two years ago Professor Gill urged the careful study of fishes, and the writer ventures to add the suggestion that much more should be written and circulated regarding the results of our studies and also of our chance observations, the latter being of the sort to which most of us are more liable. If each will write all he knows of each variety, the sum total will be none too much, but can hardly fail to be greater than has yet been printed. Of course there will be a lot of repetition, but here and there something new will appear. When the stock becomes too bulky and too much diluted there will always be somebody to simmer it down and get the actual meat of the whole into the form of a solid extract, which may prove excellent brain-food. But let us enforce the pure food law, and label facts, estimates, and hopes distinctly and separately, remembering that one fact is worth more than any amount of doubtful record. Even if an effort has resulted in failure, the failure should be made to clearly appear. This is not to be a sermon, and the frank statement of the truth is urged not because truth is the highest moral good, but because it is good business.

The following notes of a first experience with pike-perch eggs and fry are offered, not for the enlightenment of those who have handled such, but because they may serve to draw the attention of some other beginner to some of the difficulties likely to be met and also suggest indirectly some points at which advance should be made in the work with other fish as well as with these.

At 10 o'clock A.M., April 23d, arrived a case containing 1,800,000 eggs of pike-perch packed and shipped April 20th. On opening the case the trays were found to have a temperature of 45° F., and as the temperature of the hatchery water was 57° about an hour and a half was spent tempering the eggs and getting them into the jars.

The hatching arrangement available consisted of six open-top jars each having a flow of about one gallon per minute, emptying into a trough 13 inches wide, 11 feet long, and with water raised to the depth of six inches. The eggs began to hatch at once and, to keep shells away from the foot-screen, an additional screen, about three feet long made of mosquito-net with a frame fitting the trough, was placed in the trough, its up-stream end on the bottom and its other end just above the surface of the water. All seeming safe at 9 p.m., the apparatus was left to run itself over night. At 5.30 next morning the trough was running over. The foot-screen was evidently clogged and an attempt to clean it with a brush showed that it was clogged with fish rather than with shells.

Another long screen was made of cheesecloth and put in place of the one made of netting, which was moved further up the trough to intercept shells, the new one being designed to fence fish away from the foot-screen. The fish below the new screen were then siphoned out of the trough and held in cans until shipped that afternoon, a lot estimated at 400,000 being sent out 31 hours after the eggs were received.

For cleaning the screen and lower end of the trough the plan was adopted of siphoning about once an hour, the fish thus collected being held in cans, if the hour of shipment were near enough, otherwise in a second trough fitted up to receive them and provided with a flow of about one gallon per minute. The fish continuing to hatch rapidly and finding their way past the long screens, it was found necessary to tend them day and night to avoid clogging at the foot-screen.

The young fish were from the first able to go where they pleased, so well able in fact that they found their way past the long screens and even past the foot-screen occasionally, in spite of its fineness and the care with which it was fitted and caulked. Even in the second trough with its small flow they constantly drifted toward the foot-screen, so that it seemed best to siphon them and return them to the head of the trough occasionally. The fish seemed to hatch faster after the electric light was turned on in the evening, but this appearance may have been due in part to the greater distinctness with which they could be seen and the presence of their sharp shadows. About midnight of the third day, April 25th-26th, a second shipment of 400,000 was sent out, and 24 hours later an additional 200,000.

The remaining eggs were then cleaned and put into three jars, thus reducing the flow into the retaining trough. During the fifth day the eggs were again handled and the number of jars reduced to one. On the sixth day it was found necessary to clean the screen but twice and that night no watchman was needed. The number of fish hatching had now become so small that a siphoning at 9 P.M. and another at 3 next morning sufficed for the first trough. The other, which contained more fish, was protected in another way. By experiment it was found that the fish were strongly attracted by light and, by making the lower end of the trough very dark by means of a close cover and leaving the upper part open and an electric light over it, the fish were induced to remain in the upper part of the trough and away from the screen.

The seventh day, April 29th, careful estimates were made of the dead eggs and fry, and a final shipment calculated at 400,000 was sent out. A few strays found in the trough were held for observation. These grew rapidly for a few days and, their exact age not being known, attempts to feed them were begun May 2d, moss supposed to contain microscopic food, water from among such moss, fine cut liver strained through cheesecloth, and finely divided pulp from ground crawfish being offered.

So far as observed they did not feed at all until May 10th, when they began to eat one another. Two days later several instances were noted of the biter bitten. In every case the victim was seized by the tail and a fish burdened with his prey was so handicapped as to become himself an easy mark. Cases were noted where the second victim had let go his morsel and part of it floated still attached by a thread of skin and so towed about by the captor, who seemed expecting his turn next. Although active and free-swimming when hatched and apparently searching for food, they did not begin to eat one another until at least ten days old and, with none of them taking any other food (so far as known) the last survived two weeks longer, that is, at least 24 days from hatching. And, contrary to all expectations, the last survivor is believed to have been, not the most successful cannibal, but a fish which had not fed at all.

Their behavior seems to warrant the suggestion that from the first the water should contain something which the young fish can swallow. It seems likely that they may learn to eat before they are able to digest. Other creatures swallow first substances which serve rather to open the organs and be discharged than as food. Perhaps young fish learn to feed by the involuntary swallowing of particles brought into their mouths in respiration, and the voluntary selection and seizing of food comes later. Supposing this to be the case it would seem that in rearing young fish in confinement the effort should be to furnish them water supplied with something to be swallowed, almost anything being better than nothing. It may well be that microscopic creatures sifted out in the movements of respiration may form a large part of the food of fishes of various kinds and sizes. But, if pure water be insufficient for fish reared in confinement, it is not less, but more, important to see that planted fish be released where food not only may be found, but where it is so abundant as to be forced on the attention of the young fish, literally crammed down their throats. Small wonder young fish become cannibals when their comrades are absolutely the only thing in sight. From this a next inference will be that at planting young fish should be scattered.

Poachers on an alewife stream used to obstruct the fishway and help themselves to its contents and, when the suggestion most likely to appeal to them was made, that they were working against their own interests, their answer was that enough alewives were still allowed to pass to fully stock the lake above and, if all were allowed to go up, so many young would be produced that all would starve. Whatever may be thought of the argument in this instance, it is the fish culturist's business to see to it that his fish are so planted that they will not starve one another. Even while we remain ignorant of the first food of young fish and of the cause of the disappearance of the great number, which are never heard from after planting, the mere consideration of the theory of chances should lead to a wide scattering of planted fish. The enormous fecundity of fishes is Nature's admission of the perils which beset the path of their offspring. Fish culture carries them past some of these perils, but in many cases leaves them to face others equally fatal. When one fish culturist writes to another: "I have been planting young fish for 30 years and have yet to see one adult fish as a result," he is privately stating a fact which should long since have been written large on the record. To determine the fate of planted fish is not easy, and it may seem necessary to wait till the fish themselves report, but there should be clues available earlier, and the suggestion is that we watch for such and report every smallest one.

The fate of the few pike-perch fry held and nursed till all died does not tend to foster hope for those liberated, but in the absence of more light on the question of their needs and perils, the proper course would seem to be to give them as many chances as possible.

As to the time young fish should be held before planting, it is suggested that the behavior of the fish may be taken to offer a clue. Young salmonidæ lie helpless for weeks and only when the sac is absorbed do they become really alert. Then they show a disposition to scatter and perhaps they still have some weeks in which to place themselves before starvation will overtake them. Mr. Atkins' experiments in holding young salmon unfed seem to indicate this. Pike-perch fry, however, are active from the time they are hatched, and it may well be that their travels should begin at once. Even though each does no more than place a good distance between himself and the rest of his family, it will evidently have been a good move.

To plant thousands of young fish in such a situation that one able-bodied enemy can keep them rounded up till he can make away with them, or they starve, can hardly be the right way. Probably all young fish should be planted in shallow water rather than deep, since the minute life, of which their food must consist, is supposed to be more abundant in shallow water.

The season at which young fish should be produced must also correspond with the season at which their food is produced. To force the development of the eggs and liberate young fish at an unseasonable time can be of little use in fact however well it may read in a record. Where the temperature of water in which eggs are incubated is not changed artificially from that in which the young fish are to be liberated, it is likely that the development of eggs and young fish will keep pace with the development of those creatures, which are to be their food, but any interference with this scheme of things is liable to prove risky.

In this connection it may be suggested that transfers from one climate to another should be made in the egg and at the earliest practicable moment, since change in the rate of development of the embryo is believed less harmful in the early stages. Where there is to be a considerable change of climate or of water temperature, further experiments with shipment of green eggs might lead to useful results.

But rather than wander further, let us take one more look at the starting point and be done. Whenever you think you have a new idea pass it along. It may be new to somebody else, or at worst you may be able to exchange it for a better one.

SOME OBSERVATIONS IN FROG CULTURE

By W. H. Safford

The work of the Department of Fisheries of Pennsylvania in frog culture begun in the year 1903 has steadily progressed; and the action of the Legislature of that year, which passed a law giving protection to frogs has greatly increased their importance. As with any other kind of pond culture, however, we find a great many difficulties to retard our work. We also find a great difference in the modes of cultivation applicable to the several species of frogs.

In the beginning of the work we were unable to distinguish the eggs of one species of frog from another. The leopard and the green frog, being two of the earliest to spawn, were the ones first experimented with. My first year's work was with these eggs, under the belief at that time that they were the eggs of the common bullfrog. But, as the season advanced, I found, to my disappointment, that they were nothing of the kind. Out of an estimated 500,000 eggs that I had in a pond I think I did not succeed in developing more than fifty frogs.

In the meantime experience had taught us to distinguish the eggs of the common bullfrog. We found that with the exception of coloration the eggs of this species (which, by the way, is very large, sometimes reaching a weight of one or two pounds) were different in every respect from any other. For instance, the leopard, or small green frog, casts its eggs in a round, solid, gelatinous mass, which will be found in what you might call spawning grounds, where from 10 to 50 bunches can be gathered at one place. The water inhabited by these frogs is usually the pools in low, swampy lands. The common bullfrog, on the other hand, casts its eggs in a thin gelatine fluid that sometimes will cover an area of 4 or 5 feet on the surface of the water. These are usually found in a clear space of pure water. The eggs are much smaller than those of the leopard or green frog and, of course, will run in larger numbers per individual.

Of the smaller species we have found it possible sometimes to produce a few frogs the same year the eggs are cast. This does not apply to the common bullfrog, however. The eggs of this species cast in the early summer will not produce a frog until a year from that time. At the latter end of the first summer the tadpoles are very large, and a great many of them will develop hind legs. Then they seem to remain stationary until the water temperature has reached the summer heat of the following year, when the development into a perfect frog takes place in about sixty days.

It is in the second year of the tadpole's life that we find our greatest trouble. To begin with, we have insect life to contend with, such as the larvæ of the *Dysticus*, or water beetle, which are very destructive. When we have numbers of tadpoles confined in small ponds, large quantities of food must be furnished. As a rule we use fish entirely as a food at the Crawford Station. If the ponds are not looked after carefully and are allowed to become at all foul they will attract the water beetle, which will produce its larvæ in large numbers. Fish-eating birds are also a great annoyance.

The precarious stage in the tadpole's life, I find, is just at the breaking through of the forward legs and the changing of the head to the frog shape. The thinning of the skin to allow the legs to break through seems to weaken the vitality of the tadpole to such an extent that we often find them dead with only one front leg through and the other but partly out. Again we find them dead with all four legs, but the mouth still of the same size as when they were tadpoles.

As our tadpoles develop into frogs we gradually lower the water in the ponds until we have no more than two inches. The young frog requires only enough water to allow him to jump in occasionally, as three-fourths of his time is spent sitting in the grass or on the banks of the pond. If the water is too deep in the pond the frog has difficulty in getting in and out.

The fact of the matter is that it is not absolutely necessary for fully developed frogs to have any water at all. Once for a period of sixty days one pond was entirely dry. At this time it contained 15,000 frogs about three months old. It was then I discovered a characteristic I had not known of before. On going to the pond one morning I saw that there was a great shortage of frogs. Seeing none dead I was puzzled to know what had become of them. As I was preparing to make a shipment I was alarmed and began to investigate. On lifting up the overhanging grass that borders the pond, I discovered in the clay banks numerous small round holes an inch or inch and a half in diameter, holes which I knew had not been there before. Upon close examination I soon found that every hole contained one or more frogs, which, upon taking some of them out, I found to be sleek and moist as could be. The following year I found the same condition, proving beyond a doubt that frogs of this age are able to adjust themselves to the absence of water.

Ponds at the Crawford Station are constructed in the following manner: The excavation is about 50 feet long, 25 feet wide and 20 inches deep. About 3 feet from the edge of the pond on all sides a 12-inch board is set in the ground about 6 inches deep. To this are attached uprights about 3 feet in height. On top of these uprights a 6-inch board is placed flatwise, the outer edge even with the uprights and the remainder projecting over the pond. To the base board and top board is nailed ¼-inch mesh galvanized wire. This fence serves a twofold purpose. It not only secures the frogs in the pond, but also excludes snakes, which are great devourers of tadpoles and young frogs. We construct our ponds for holding adult frogs in exactly the same manner with the exception that we provide a hibernating place. This is in the shape of a hole from 3 to 4 feet in diameter and about the same in depth.

To one having no experience, the propagation of frogs would seem a very easy proposition; but never was there a greater mistake. In the early springtime one can pass through any section of the country and find every pool black with tadpoles, which would seemingly promise millions of frogs. But go back over the same ground in the autumn and the number of frogs you will find will not be very large.

Since this work has been taken up by the department, we find the people so impressed with its importance that we are simply flooded with applications for frogs.

DISCUSSION

Dr. Theodore Gill, Washington, D. C.: The habits of our batrachians are not so well known as they might be, but still they are not entirely unknown, and within the last few years have been the subject of investigation by several members of the Cornell University staff, and especially by Dr. Wright. Distinctive characters have been found in the eggs and in the mode of oviposition as well as in the habits of the larvæ after exclusion from the egg, and information on these points doubtless could be obtained. Some publication has been made also in *The American Naturalist,* but as yet we know comparatively little concerning the young of these batrachians compared to what they know in Europe.

In Europe the mode of oviposition, manner of the assemblage of the eggs, and all the details of the early life history of frogs, as well as toads, their relatives, have been made known, and especially they have been made known in a beautifully illustrated work by Dr. George A. Boulenger, published by the Ray Society about ten years ago, on the subject of "The Batrachians of Europe" (in two volumes). Much information relevant to our own species of frogs might be found there.

Mr. Safford: I wish to state that I have a series of specimens of frogs, from the hatching egg to the fully-developed frog, which I should be glad to exhibit to any of you who may feel an interest in the matter.

President: Please bring them to the aquarium tomorrow morning. That will be the best way.

WORK OF PENNSYLVANIA IN STOPPING WATER POLLUTION

By W. E. Meehan

Until about four years ago Pennsylvania gave little heed to the pollution of its streams and ranked near the foot of the list of states in this respect. The streams were looked upon by the owners of industrial establishments, by municipal corporations, and even by thousands of citizens, as the natural sewers for all kinds of filth. Public sentiment in favor of purifying the water so that it could be used for domestic purposes and would be healthful for both human beings and fishes grew rapidly until finally laws were enacted which placed Pennsylvania among the front rank of states with respect to water pollution.

At the time of the passage of these acts more than half the streams in the western part of Pennsylvania were polluted to such an extent that the majority of them contained not only no fish life, but not even vegetable life. The central part was in a little better condition, the northern part was nearly as bad as the western, and the eastern part was also bad, though less so than the others.

The Legislature placed great powers in the hands of the Departments of Health and Fisheries, and between the two it is almost impossible for any person in Pennsylvania to empty deleterious substances into the waters without violating the law. To empty into a stream anything injurious to human health is unlawful. To empty into a stream anything injurious to fish or to fish food is against the law, unless it can be proven to the satisfaction of the Commissioner of Fisheries or the courts that every reasonable and practicable means has been employed to prevent the pollution of water by the specific substance. It is not necessary for the state to prove that any particular fish were killed by a specific substance. It is only necessary to prove that the waste or substance is injurious to fish or to fish food to call for its abolition.

The Departments of Health and Fisheries found a gigantic problem confronting them. Municipalities could not change their sewage system in a day, neither could the manufacturers stop polluting the streams within twenty-four hours without closing down their establishments. Both Departments therefore had to make haste slowly in the enforcement of the laws. A rapid glance over the State would indicate that the progress in purifying the streams is less than has actually been the case.

The Department of Health has stopped the drainage from cesspools in nearly all parts of the state, outside of the cities. A number of the towns have built sewage disposal plants and nearly every town and city in Pennsylvania has been served with a decree to have its disposal plant completed within a definite period. In some cases until the disposal plants are completed it is unwise to enforce the law and put a stop to certain forms of pollution above those towns, because they act as neutralizers to the sewage below, and if the pollution were stopped at once disease epidemics would probably follow immediately. The Department of Health has in the meantime compelled hundreds of establishments to outline plans and experiments so that certain serious pollutions may be stopped within a brief time. Many other sources of pollution outside of cesspools have been entirely stopped by the Department of Health.

In the meantime the Department of Fisheries has not been idle. It has been, of course, working in accord, as far as possible, with the Department of Health. It aimed to secure the co-operation and good will of the manufacturers while making it clear that the law must be obeyed, and success has been achieved to such an extent that it has not been necessary in two years to prosecute more than two dozen manufacturers. There are today practically few saw mills in the State emptying any sawdust in the streams.

In that time nearly 200 owners who had previously been allowing the sawdust to escape now take care of this product by burning it, selling it or stacking it so that by no possible means can it be emptied, flowed or washed into a creek. This alone has been a big step toward the purification of the mountain streams of Pennsylvania. About 400 manufacturers in other lines have either provided permanent or temporary purification devices, and some are actually making money out of by-products.

Two years ago the Upper Allegheny River in the State was an offensive and ill-smelling object. Today there is very little pollution emptying into it as far south as Oil City and it is rapidly assuming the appearance of a clear, pure stream. Little else today, except the sewage from the town of Warren and a small amount of drainage from the independent oil refineries, pollutes the river above Oil City. All the acid works which formerly emptied their waste into that river have disposed of it otherwise and so have the owners of industrial establishments, while the indications are that the owners of the oil refineries will have completed their purification plants within twelve months—purification plants which will yield them a revenue. The change in the Upper Allegheny River is remarkable to anyone who had cognizance of that river twenty-four months ago.

The worst polluted stream in the State is the Clarion River. From its source to within twenty miles of the town of Clarion there was not a living thing, animal or vegetable, and from that point to the mouth there were only a few fish of the hardier kinds until about the middle of June. Above Clarion the effluvia were so offensive that it was almost unendurable to be upon the banks during the months of July and August. This stream received the attention of both the Department of Health and of Fisheries.

The key to the whole situation in that stream is at a town called Johnsonburg. Here there was a huge paper plant that emptied about twenty million gallons of waste water into the river daily. Under a decree issued by the

Department of Health the town of Johnsonburg is building a sewage disposal plant which is nearly completed, and through the work of the two Departments plans were made by which the paper company first is to have the town of Johnsonburg take care of the waste by its disposal plant, second, the paper company is to install apparatus for the purification of the water and which will produce valuable by-products. This device will cost in the neighborhood of $100,000, but when the sewage disposal plant and these devices are completed the waste water now inexpressibly filthy should be over eighty per cent pure. Within six months afterwards every acid works, and there are more than a dozen, and every tannery will be compelled to dispose of its waste otherwise than by emptying it into the Clarion; and by the end of 1911 the Clarion River should be a reasonably clear stream, fit for fish life and domestic purposes.

The paper factories and tanneries, the worst polluters of streams, are the hardest to deal with owing to the difficulty of thoroughly purifying the water without closing the establishments. The Elk Tanning Company and the independent tanners have all been served with notice by the Department of Fisheries to install temporary devices for purifying the water by the first of the year at least.

All the pollution of the Juniata River from source to mouth, excepting from about five establishments, has been stopped. At least twenty-five per cent of the polluted streams in the eastern and central and northern part of Pennsylvania have either been purified or greatly improved within the last two years with less than three dozen suits instituted by the two Departments. The strength of the law is illustrated by the gratifying fact that in the lower courts every suit under the provisions of the present law has been won by the Commonwealth and the manufacturers fined. One case of the Department of Fisheries in the county court under a previous law which was decided against the state, was taken up on appeal to the Superior Court. It was then taken to the Supreme Court, which sustained the Superior Court, making the pollution law absolutely effective. The Department of Health at the same time had its law questioned, the case was appealed, and the Supreme Court decided in favor of the Department of Health, or the state, in this case also. Unless interfered with by adverse legislation at the coming session of the Legislature, there will be a big advance in the next twelve months, for the foundation for purification has been well laid.

I am glad to see a resolution passed today in regard to the purification of waters, for it may be that when the time comes this will help to prevent any possible repeal or modification of the Pennsylvania law. It is a good law and probably one of the strongest there is on the statute books of any state. It was passed at the last session of the Pennsylvania Legislature in 1909.

THE PRACTICAL ENFORCEMENT OF FISHERY REGULATIONS

By Kelly Evans

In the fifteen minutes at my disposal I shall endeavor to give you a few ideas and observations based on the work I have been doing and the experience I have gained in the course of the last year and a half.

A royal commission was issued about a year and a half ago by the Ontario government for the purpose of having investigations made into all matters connected with the fisheries and game of that province, and since that time I, as commissioner, have been endeavoring to get information and collect evidence upon the many and various problems involved in such an inquiry. Now, you can easily imagine that to give the faintest idea of the scope of such a work would be an impossibility in a few minutes, and so I have tried to cull just a few basic ideas, as it were, to lay before you. I shall divide the subject into two main divisions, basic causes and basic effects.

I have found that the two basic causes of depleted fisheries are (1) non-recognition by the public of the importance of the fisheries, and (2) the political influence of the net fishermen. As basic effects I give you (1) that the officers employed by the states or provinces to enforce the fishery regulations are paid insufficient salaries; (2) that many of the men so employed are not qualified for or suited to the positions; and (3) that business methods are sadly lacking.

I will give a few words on these main features and also endeavor to point out to this Society what appeals to me as a practical plan whereby the Society can help in certain directions and aid materially in securing the proper enforcement of the fishery regulations.

Now, gentlemen, in regard to the non-recognition by the public of the importance of the fisheries: I have found all through the Province of Ontario that the people are more or less apathetic upon these questions and do not, as a general rule, realize the interests which they have at stake. I have found, however, under the continually advancing price of foodstuffs, of which you are well aware, that when it was explained to people that did they take a greater interest in these questions there would ensue a cheapening of fish food, they immediately became interested, more particularly so when it was pointed out to them that by bringing their influence to bear on their representatives in both the federal parliament and local legislature, especially where such members represented the principal cities of Ontario, they could materially hasten this end inasmuch as the influence of a handful of net fishermen would speedily be diminished. As a matter of fact, I may tell you that if you take one portion of Lake Ontario, namely, the Bay of Quinte, which undoubtedly is the natural spawning ground of the bulk of the whitefish in the Canadian waters of the lake, 250 net fishermen have for 40 years practically dictated what the regulations should be. There are 350,000 persons in the city of Toronto alone, yet through ignorance and apathy they have allowed those 250 votes to bring about a condition by which the very lake that laves the front of the city has not for a good many seasons given them (and, in fact, may be said to be practically incapable at the present time of yielding them) a reasonably adequate supply of fish food.

Many schemes and methods for improving the fisheries are devised, many regulations have been enacted, most of which have, at least, some good points about them; but I take it that you will all agree that the main difficulty is to get the scheme, method, or regulation carried out. To achieve this, the people, the general public, must first be interested. Therefore, if a way is open to you in any way to influence the people in the direction of supporting the regulations or methods that you recommend or that happen to be in force, why not take it?

I quite realize that commissioners cannot take part in politics, but I presume that members of this Society can give lectures, and here is the very point that I wish to bring to your attention. I understand that the funds of the Society are not great; that you have no means of getting a fund of any great proportions; but, on the other hand, there are many of you who are capable of giving very interesting papers or delivering lectures that would appeal to laymen. In the smaller towns in the various States and Provinces there are usually societies which have halls for the purpose of giving educational lectures. Now, if a publicity committee was organized by this Society and volunteers were called for from among the members of the Society to help in this work, I believe that by the delivery of interesting papers, not of a technical kind but of a nature likely to appeal to the general public, much could be accomplished in the direction of stimulating that public to take an interest in fishery questions, and consequently to demand and secure the proper enforcement of the fishery regulations.

One of the basic facts I mentioned in connection with the present unsatisfactory state of the fisheries was the insufficiency of the salaries paid to the fishery officers. This is, I believe, directly to be attributed to the basic cause of the little interest taken in the question of the fisheries by the public and the general lack of appreciation of its importance. Where the general mass of the people do not look upon a natural resource as very important, it is only to be expected that the majority of the subordinate officials of the department concerned with that resource should not be paid sufficient salaries. Once again, if you can interest the public in these matters, the whole department will be viewed in a more serious light and its officers will receive more reasonable consideration in the matter of pay.

Then as to the unsuitability of the men employed as fishery overseers: I do not know your methods here, but I fancy that, after all, our systems of government and our general political schemes so closely resemble each other that possibly what we feel you feel. I find in our province, for instance, that when there is a vacancy for the position of fishery overseer, the patronage committee, sending a member to the local house, practically has the appointment in its hands. The committee cares not one whit for the capabilities of the man to be employed as fishery overseer; they look for what he did at the last election. Now, if the general public was more fully seized of the importance of the fisheries, greater interest would be taken in that appointment and there would be an end to that state of affairs whereby some retired butcher, for instance, who never saw a fish in his life except to eat it, and who would be likely to tumble out of a boat on one side if he got in on the other, is appointed a fishery overseer. I realize that New York State has put this matter on a different basis through the Civil Service Commission act. At any rate the men have to pass an examination before they are appointed overseers. We have no such arrangement in our province, and I fancy in a great many of the States of the Union there is nothing of that kind. In my opinion, however, the matter is far too important to allow of purely political considerations deciding the selection of an officer, and some form of board for the examination of applicants for the position of overseer is absolutely indispensable to insure that the officers shall be properly qualified in every respect.

Now as to unbusinesslike methods: Take, for instance, the equipment of the fishery protective service. I dare say that some of the commissioners present realize how absolutely unsuitable many of the boats, used in the fishery protective service on the Great Lakes or on the small lakes, are for the purpose for which they are employed. I have found in our province that all these boats are of different builds and different speeds, and that a considerable proportion of them are altogether unfitted for the work which they are supposed to perform. There is no businesslike method in the system. When these matters were brought before certain persons who occupy seats of the mighty and when certain criticisms were made in reference to these methods, these gentlemen said: "You blame the administration. It is not the administration that is to blame; it is the fact that the people do not take much interest in this question. Go out and interest the people first and then we will see if we cannot vote higher salaries for our officials and put the system on a more businesslike basis."

Again, all too often offenders against the fishery regulations, who are taken red-handed in some infraction of the laws, are able to use certain influences by which they succeed in escaping the legal penalties. If the general public took a greater interest in the whole question, such juggling with justice would not be tolerated. It is not allowed in the case of the customs. Why, therefore, should it be permitted in the case of the fish and game department?

As to the effect of lectures: I am a layman as far as scientific fish culture goes. I joined this Society in the hope of educating myself in this direction. I remember listening at Erie, Pa., to that brilliant paper by Dr. Birge on "The Respiration of an Inland Lake." Now that paper was a beautiful thing. It was, first of all, a literary gem. Secondly, it contained a great deal of information that would be interesting to a mixed gathering. Why should not that paper have been read in many parts of the continent? It was in no sense parochial, but, on the contrary, of wide, almost universal, applicability. Mr. Whipple informed us last year at Syracuse that he had given a lecture or an address on about 100 nights in each year that he held office, and he traced on that occasion the effect of those lectures in the greater readiness that the legislature had displayed in voting him supplies. I can well credit this, for the wishes of the people must, to some extent at least, be reflected in the actions of the executive.

If in pointing out to you the value of popular education I can convince the Society that it might be worth while next year to consider the question of establishing some description of publicity department, not with a view of spending money, because, so far as I can make out, we have no money to spend, but with a view to enlisting the volunteer assistance of different members of the Society in endeavoring to interest the public in the question of the fisheries, I shall be more than pleased. I find, as possibly do some of you who take an interest in the creation of associations with a view to awakening public opinion, that work is always more effective in the country, in the back townships, in the mountains, than in the cities. People in the cities have too much to do, are too busy, have too many lines of amusement, too many distractions, to get together for any lectures, but in the smaller places it is quite easy to find audiences who are appreciative and who often will come miles to hear a good lecture. The people in the back townships and in the country have votes, and in the past have, in many instances, used those votes to initiate a policy of wide, if not national, importance.

Before sitting down I wish to compliment Mr. Meehan on what he has accomplished and to say that it will be of the greatest assistance to us in the Province of Ontario. You must remember, in this question of the pollution of waters, who has been at the back of us and whom we have to fight. Where our main pillar of support is an apathetic public, and where we are necessarily making it inconvenient for entrenched capital, for large industries, if we are to accomplish our purpose it is only too evident that we have a hard fight to make. That Mr. Meehan has succeeded in the State of Pennsylvania to the degree that he has, is a most encouraging thing to me. If he will let me have the act as it is written, and if he will give me a summary of its practical results, it will, I am sure, prove most useful for my purpose. I think, in fact, that it may enable us in the Province of Ontario still further to improve our act governing the pollution of waters. Recollect that we have a general federal act in Canada against the pollution of streams. We have always had it. But who has there been to enforce it? An act may be on the statute book stating that such and such a thing shall not be done. If the public is apathetic about it, and the people who desire to abuse it are powerful, why, naturally, the act becomes a dead letter. Perhaps this is equally applicable to your country as to mine. Anything, therefore, that this Society can do to reach and interest the plain people will, I believe, be of immense benefit to the cause it represents, especially in the direction of securing the practical enforcement of the fishery regulations.

The members of this Society meet, as I take it, to educate one another; to advance the science of fish culture. It is a meeting more or less of experts. I would ask them, however, not to disregard the little suggestion that I make; to come down, as it were, from their position as experts and to occupy the platforms before simple country audiences, and to talk plain facts to the plain people.

DISCUSSION

Mr. W. E. Meehan: As my friend Mr. Evans has mentioned my name in connection with the work in Pennsylvania, I will say that I tried to make it clear in my paper that whatever credit might be due to the Department of Fisheries for what was done, equal credit was due to the Department of Health, which has done quite as much as the Department of Fisheries.

If a person were riding through Pennsylvania on the train, he might think nothing has been done, but I want to say particularly with reference to what Mr. Evans has said concerning publicity and educating the people, that I am in hearty accord with that proposition. It has been a policy of mine ever since I have been commissioner. I suppose I spend one-third of my time in the State of Pennsylvania, in the smaller towns principally, talking fish culture, fish propagation, and pollution, wherever I get a chance, and it has a wonderful effect. It has had much to do, I think, with solidifying public sentiment. It has gone this far: Public sentiment has got so strong in the State of Pennsylvania that every now and then we are honored, either in the Department of Health or my Department, by a request for us to be a guest and to talk on this question of water pollution and the best and wisest methods of getting rid of it. It has progressed to such an extent that we are often called upon to do that. I believe it is a good thing. I think if it were more general the sentiment would be stronger in the states. Mr. Titcomb does the same thing in Vermont, and I suppose many of the commissioners in other states do the same thing. It should be followed systematically and continuously.

Mr. R. E. Follett, Pittsfield, Mass.: I do not think stream pollution is a question of saving fish life altogether, but it is a question of clean, decent, right living. In England it is incumbent upon every city, village and hamlet to see to it that the rivers are just as pure below their sites as above. This is the reason they have salmon fishing in their streams there.

Dr. George W. Field, Boston, Mass.: We have had an exceedingly acute condition in Massachusetts, and, indeed, in all New England. In Massachusetts in the last three years we have sent two cases to the Supreme Court through the organized effort on the part of the sawmill people to fight the sawdust law. They claim that the object of the state in preventing the introduction of sawdust was depriving them of rights which they had had since the settlement of the country. The Supreme Court held it was not possible for a mill owner to acquire such rights against the state; that even if they had been dumping the sawdust in for 20 or 200 years they did not thereby acquire the right to do so as against the rights of the state. So that matter is pretty definitely settled.

A case more recently decided was that in taking into consideration the value of a stream as a fishing stream as compared with the manufacturing value, we were not to consider the actual number of fish in the stream but to consider its potential capacity for producing food fish. Judge Akin, of the Superior Court, who handed down the opinion, said he had visited the stream in person, and that while he believed thoroughly that the stream would not produce at the present time half a dozen trout in the course of a year, there was no question but that this stream, if properly handled and put into its pristine condition, would be exceedingly valuable to the people of the state. Therefore, he believed the commissioners were right in considering the potential capacity of the stream. That settled another important question, for the reason that our law says that if the commissioners assert that the fishing in the stream is of more value than the manufacturing interests, the pollution of the stream shall be prohibited, so far as sawdust is concerned.

But the law as it formerly existed was utterly inadequate. The manufacturer would be prohibited from putting in sawdust, and at the same time he might put in shavings, and when we prevented them from putting in sawdust they went on and put in ten times the quantity of shavings. The ultimate effects, of course, were worse from the shavings than from the sawdust.

The last Legislature passed a law which actually prohibited the introduction of any substance which would in any way directly or indirectly affect the food of the fish or affect the fish themselves. It provided for a public hearing and also for a review of the conditions by the courts if the manufacturers so decided. Extreme pressure was placed upon Governor Draper to veto this bill. The Governor himself is a man interested in large manufacturing enterprises. He saw the bearing of the thing upon the manufacturers and it went through his mind, without doubt, that if he vetoed the bill he would make himself solid with the manufacturing interests; if he signed the bill he would be going against his friends. But he stood right up and said: "Now this is to the interest of all the people, and although I am losing votes and prestige with the manufacturing interests, I am going to sign this bill," and he signed it. I believe this marks a very great advance in the center of a community where the streams are probably more polluted than in any state in the Union.

Mr. R. E. Follett: I am sure we all understand that the condition of our state today is due to an indifferent public. I am glad to hear some of our commissioners say that they have done something. It is encouraging. I am especially interested in what Mr. Meehan has said today. I am not sure that our courts will sustain the commissioners, but they can at least keep the sawdust out. I understand it is another proposition to tackle a million dollar corporation. But our large rivers must ultimately be dealt with by the Federal Government. Take, for instance, the Connecticut River; it is polluted by Vermont and New Hampshire before it reaches Massachusetts, and it is in a hopeless condition when it reaches Connecticut.

Mr. Daniel B. Fearing, Newport, R. I.: In the little state from which I come, of which I have the honor of being one of the fish commissioners, we are called the commissioners of inland fisheries, and our chief interest is apparently lobsters. We have nothing whatever to do with the shellfish—oysters, etc.—but the shellfish commissioners of Rhode Island are now doing something in line with the present subject, and I think we are the only state that has now got a commission with power. Oysters are forbidden to be sold or taken out for purposes of sale in prohibited areas in Narragansett Bay; and the map which the shellfish keepers have is remarkable. It is all marked out in the way shown. There is prohibition of law against selling any oysters taken from these areas. I think this ought to be copied in all states that raise oysters. An oyster that comes from Rhode Island has got a trade mark on it, and you can eat it without getting typhoid fever.

SUCCESS IN CAUSING THE PEARL OYSTER TO SECRETE SPHERICAL PEARLS

By Bashford Dean

The following notes were presented:

1. The Japanese have, during the past decade, developed a small but prosperous industry producing culture pearls which are hemispherical or nearly spherical in form. The process by which they are produced is well known, centuries old in the East, and there is considerable literature dealing with it.

2. After experimenting several years the late Dr. T. Nishikawa, formerly of the Fisheries Bureau in Tokyo, and later associated with his father-in-law, Mr. Mikimoto, of Tokyo, the leading pearl culturist of Japan, devised a method by which the pearl oyster could be caused to produce spherical pearls. This appeared to be the first time that such a result was obtained. The speaker has authority of one of the foremost zoologists of Japan that the method was successful, and as evidence of the success of the new method he was told that during commencement time at the Imperial University of Tokyo (shortly after Dr. Nishikawa's death) pearl oysters were brought before the Emperor and that Professor Iijima, head of the department of zoology, demonstrated pearls of spherical form *in situ,* produced by the Nishikawa method.

3. The new method is a secret one, with one or more patents pending.

4. Whether the process is now producing pearls in the Mikimoto establishment or elsewhere is an important question commercially. The speaker has not seen a Nishikawa pearl, and has no accurate knowledge that the new pearls are in the market. The matter, however, even in its latent stage, is of interest generally, for the expense of producing a spherical pearl by a culture process is but a small per-

centage of the normal price. It is suggested, therefore, that pearl experts would do well to give the actual Japanese methods their careful attention.

[Since the meeting of the Fisheries Society word has come from the Science College in Tokyo that extensive expriments are under way to improve the process above noted. The process is still a secret one, and no one but the actual operators know the way in which the artificial cores are inserted between the shell and the mantle of the oyster. From the tenor of the letter one infers that the pearls of these experiments have not up to the present time been large enough to "spoil the market." It would be of great interest to obtain details at the Japanese end of the line.]

DISCUSSION

Dr. W. P. Herrick, New York City: This matter of the mechanical production of round, perfect pearls is of a great deal of interest to me, because for nineteen years it has been my wish to make experiments in that line. It was only this summer that the opportunity came, however, on the 10th of July, when I commenced some work of that nature. I used two varieties of mussel, the soft-shell clam, and the oyster, and then worked on the various Unios; and afterwards I got some of the western varieties through the kindness of Dr. Coker. Now this matter has come up so quickly that there is little more to show you than a few specimens. As I understand it, these are the first experiments of the kind that have been undertaken in America, and the first on American Unios. I think it might be interesting to exhibit the specimens so far obtained from the experiments.

Perhaps, by way of explanation, it might be well to add that it is now generally admitted that an epithelial cyst is essential to the formation of a round pearl. It also might be interesting to add that Dr. Hornell, in speaking of cysts in this regard, says that these cysts though small are usually visible to the eye and measure 1.3 mm. in diameter; he afterwards says that some are about half that diameter. That would be about a thirtieth to a sixtieth of an inch. Dr. Jameson, in speaking of the mussel cysts producing pearls, says that they are about a millimeter in diameter and of a yellowish color. So just in explanation of the specimens I was going to submit I make this statement.

I will say that Professor Nishikawa's investigations are wonderful. I have not seen a pearl; from a press notice, however, it appears that a good many of those pearls had a black spot, but that he has produced a perfect, spherical pearl.

I would like to say (exhibiting specimen to Society) that this specimen from a Unio shows a little yellowish-brown cyst about half the size of a pin head. The formalin has bleached it out considerably and it does not show as well as it would otherwise. There was another one which in dissecting I cut half across, so that it does not show quite so well.

I show you now a section of a somewhat similar cyst except that it was pinkish; is a 45-day growth, in the other it is from 23 to 28 days. This is only an 11-day cyst; it is rather pinkish, instead of being yellowish-brown, as the other one. Dr. Field kindly made these sections for me, and I can only add, in explanation, that the cyst has a lining which, I think, is epithelium. I have submitted it to some who believe that while not absolutely typical epithelium, as it is very young, still it is an epithelium lining of the cyst.

REMINISCENCES OF FORTY-ONE YEARS' WORK IN FISH CULTURE

By James Nevin

As everything in the fish line has been threshed out time and time again at our former meetings, it is hard to arrive at something new to present to the Society. I therefore concluded to submit this short paper of reminiscences which I trust will interest you for the moment.

Forty-one years is a long time to devote one's self continually and entirely to one occupation. Little did I think forty years ago when I drove my superior officer, Samuel Wilmot, to the depot to take the train to New York to attend the first meeting of this Society, that in 1910 I would be sent by the great State of Wisconsin, as its superintendent of fisheries, to attend a meeting of the same Society.

From 1869 to the present time I have not lost a day in the work of fish culture. My first work was with the late Samuel Wilmot, of New Castle, Ontario, who was superintendent of fish culture of the Dominion of Canada; under him I served for thirteen years. When I was fifteen years of age I was employed picking salmon eggs at the munificent sum of 25 cents per day and, as the Irishman said, "I had to ate meself at that." At that time our work was very crude as compared with modern methods. In the fall of the year the salmon would ascend Wilmot's Creek in large numbers; we caught them in traps and transferred them to pens built in the creek, and there they were held until ready to spawn. After relieving them of the eggs we returned the fish to the stream and permitted them to find their way back into Lake Ontario. I assisted in packing the salmon eggs for which it is recorded in history the American Government paid $40 in gold per thousand.

Every fall Mr. Wilmot went to the Detroit River to collect whitefish eggs, and if he succeeded in procuring a couple of million we considered ourselves in great luck. The first whitefish were hatched in 1869 and some of them were placed in a spring pond previously covered with boards. In the fall of that year we found from three to four dozen of the fish in the pond and some of them had attained a growth of six inches. In the fall of 1870 Nelson W. Clark came to visit the hatchery, and I had the pleasure of showing him the first whitefish artificially raised in confinement. Seth Green, who was collecting lake trout eggs at Brighton, visited the hatchery that fall, and I also had the pleasure of showing him the same fish. These are the only whitefish I ever saw raised in confinement and they lived in the spring pond for several years.

In the fall of 1873, when nineteen years of age, I was sent to Tadousac, in the Province of Quebec, to start operations in a salmon hatchery at the mouth of the far-famed Saguenay River.

During the summer of 1875 I was placed in charge of the hatchery at Sandwich, Ontario, which was built that year and was the most extensive station in America. The hatchery was then equipped for the propagation of whitefish. The eggs were hatched on trays, and had to be picked and feathered the same as eggs of lake trout are today. I have often listened to a discussion as to who was the first fish culturist to hatch whitefish in bulk,and I believe that my work in this direction precedes any who claim that distinction. During the winters of 1873 and 1874 the following system was pursued on a small scale: Hatching pans, as we called them, were used; these pans were about 8 by 12 inches, and had perforated zinc bottoms. In them we placed from 3 to 4 inches of eggs and allowed the water to enter at one end, the pressure forcing the water up through the holes in the bottom and giving the necessary circulation.

During the winter of 1874 we worked on a funnel-shaped can having a capacity of from one to two quarts of eggs and so constructed as to use either the top or bottom for the entrance of water. During the summer of 1876 Mr. Wilmot patented this can, covering the manufacture of it in either wood or metal. It was the summer of 1877 that Mr. Chase patented his glass jar for the hatching of whitefish eggs. This will show that we in Canada, as well as Mr. Chase, were at that time working on a plan for the hatching of whitefish eggs in bulk and in large numbers.

I claim the credit of being the first to hatch pike perch eggs. Our first collection of the eggs of the pike perch was made April 2, 1876, on Saginaw Bay and were taken to the Sandwich hatchery. We lost the entire first lot and I returned to Bay City to secure a second supply, from which we hatched quite a sprinkling of fry. After liberating the same, we went to the St. Clair River and collected eggs as late as May 24. From this collection our hatch was more successful than from the eggs procured at Bay City. We placed the eggs on the trays we had for the hatching of whitefish spawn. On account of their adhesive qualities, it was necessary to lay them on the trays in order to give them circulation. One day after we had a heavy storm and the water was very roily and dirty, we noticed that after the eggs had been run through a screen and were placed on the trays in a loose condition, the water caused the eggs to separate and we experienced no more of the trouble I mention above. This discovery was made in the spring of 1880 and since then we have always used either clay or black mud to roil the water when the spawn was placed in tubs for washing and hardening before being put on trays for shipment to the hatchery.

It also seems apropos for me to mention at this time that I think I was the first to transport and confine black bass in ponds for natural production. We secured bass in the spring of 1873 in the Bay of Quinte, at Belleville, Ontario, and transported them to the ponds at Newcastle. I remember as well as though it occurred yesterday that the first black bass fry were hatched on the tenth day of June. This work was continued during 1874 and 1875.

On August 16, 1882, I was appointed superintendent of fisheries by the State of Wisconsin and assumed the duties on September 1st. Our department met with many reverses before success finally crowned our efforts. The commission was organized six years previous to the time of my appointment. During that time it experienced the advent and passing of three superintendents, suffered the ridicule and abuse of the press, and indications pointed toward the abolishment of the department by the next Legislature. At the first meeting of the commission after I had taken charge, President Philo Dunning stated his intention to resign. The other members immediately said that if he resigned they would all follow his lead, as none of them wanted to be in at the death of the commission, as they expected the department would be wiped out by the coming Legislature. Everything was in a state of chaos, but the final outcome was that, sink or swim, live or die, survive or perish, we would combine our efforts and fight to the last ditch. After killing a bill to abolish the commission and quieting antagonism to appropriations, we passed from the depths of despair into the light of assured success.

Many hardships must be endured in connection with our work of collecting eggs in the fall of the year on the Great Lakes. During the same storm in the fall of 1884 in which my friend Oren M. Chase, of Michigan, was drowned, I was collecting whitefish eggs on Green Bay off Fayette, Mich. The wind had been blowing hard for several days and it was almost impossible to get the fishermen to go out and lift their nets. One day the wind calmed down considerably. I was on the anxious seat about procuring eggs and as an inducement I offered one William Winter ten dollars to go out and lift. He replied that if I was not afraid he would go out with me. He had a sail boat and with it a small pound-net boat in tow to raise the nets. We lifted several nets and I was in the pound boat spawning fish when a gale sprang up and with it came snow. The tow-line parted, Winter could not come about to pick me up, and I was adrift on the waters of Green Bay, six miles from shore. I had to drift with the wind and finally landed in the vicinity of a lumber camp. Perhaps I was not glad when I struck the beach! I spawned fish most of the time I was drifting and had some thirty gallons of whitefish eggs when I landed. I took them up to camp, put them in wash tubs, and had them all ready for trays before I went to bed in the camp. That night the bay froze over solid. I had some eggs in boxes at Winter's fish house and when I reached there the next day the top trays were frozen solid so that I could not remove them without breaking the boxes. As it was, I shipped the eggs in the boxes to Milwaukee the next day. I marked the boxes to keep them separate as I thought them valueless and frozen. The eggs, however, turned out well with the exception of those in the top tray. Since then I have never been afraid of keeping eggs too cold when on the fishing grounds or in shipping them to the hatchery.

In the fall of 1885 I experienced another wild night on the tug *Anderson,* en route from Beaver Islands to Escanaba. I had some sixteen million whitefish eggs on board and the boat was loaded down with fish. A storm came up after we left the Beavers, and to save the boat we had to dump six cars of fish into the lake. We also broke two of the wheel blades of the tug. We succeeded in landing at Escanaba, Mich., on December 10th, with the temperature at 10 degrees below zero, the tug heavily iced and almost ready to sink when we touched the dock.

We now have six hatching stations excelled by no other state in the Union as to buildings, grounds, and equipment. But few states exceed Wisconsin in the annual distribution of fish. We have been fortunate indeed in the selection of men as members of the commission. Succeeding governors have not seen fit to change the personnel of the commission, as is the custom in some states. The public has acquired utmost confidence in our department, and the legislative body is liberal in the appropriation of funds to enhance the efficiency and scope of our work. I am proud to say, and I feel that my assumption is just, that I have taken an important part in making our state commission of fisheries what it is today.

PERSONAL FISH-CULTURAL REMINISCENCES

By Frank N. Clark

The President's introduction was a little embarrassing in some respects. I do not wish to take the honors from any one. Mr. Nevin has had a long life in active fish culture, and there is no one that knows it better than I or our President. In fact, along the lines in which we have all three worked, and they have been similar of course, I do not think that I am egotistical at all when I say that we are probably three of the men that have been the most active for thirty to forty years.

The first fish egg that I hatched antedated Mr. Nevin's but very little. In the winter of 1865-66, in connection with my father, I succeeded in hatching and rearing one trout to be three months old. That was the total output for the first season.

Since that date I have been connected with hatcheries that have turned out as many as 600,000,000 eggs in a season—no, I will not say turned out, but collected—probably 450,000,000 fry or thereabouts were turned out.

I was rather young when I began, nothing but a mere boy, and during the earlier years probably Mr. Nevin devoted more time to the work than I did. Of course, my work was private, in connection with my father's work; I was in the hatchery during the winter and at other times I was otherwise engaged.

Sometimes I think that the younger men of the commissions, and the younger men of the Society, do not realize what the pioneers in fish culture went through. Take, for instance, Seth Green, Mr. Wilmot, and my father. It was practically the starting. Of course, it is true that there were one or two others that had hatched some fish before that time. But those three were really the pioneers in presenting fish culture to the American people—there is no question about it. In regard to the incident, Mr. Nevin speaks of in his paper, of taking whitefish eggs on the Detroit River, he did not mention the fact, but the probabilities are that it was just a year previous to the same season that Mr. Wilmot, Seth Green, and my father sat down to a fisherman's table on Grassy Island and had their dinner—Grassy Island, by the way, is one of our biggest egg-collecting stations today on the Detroit River. One year previous to the time referred to by Mr. Nevin my father was there and took a few whitefish eggs (I think about 500,000), and we succeeded in hatching out a fair percentage, though nothing like what we do now.

I pass along down until 1874, when I commenced my active fish-cultural life. Since that time I have done nothing but fish-cultural work, and, in fact, ever since that time the most of my work has been for the United States fisheries service. In the winter of 1874 I began my connection with the United States Fish Commission.

I do not know, Mr. President, that I could do better than speak of some of the men that I met during those days. One, a name that we all honor, is that of Professor Baird. I well remember my first trip to Washington in 1874, when I first met Professor Baird. I was, of course, associated with him personally on many subsequent occasions and also by correspondence. I have letters in my files written by a clerk with a pen as dictated by Professor Baird, and I now enjoy reading over these official letters. They were not the same as those we receive today. Now, when we get an official letter from Washington, written perhaps by some one at the head of a division who is a personal friend of ours, it is the coldest thing a man ever got—it is "Sir" every time. I can show you hundreds and hundreds of letters from Professor Baird—official letters that did not have any stamp on the envelope—and they are addressed "Dear Mr. Clark." I tell you, gentlemen, when you look over those letters of the men that you have associated with it makes you think.

The time we met at Wood's Hole a few years ago, when that monument to Professor Baird was dedicated there, it certainly touched me to the core to think of such a man as Professor Baird, a man who did not think of anything but his work, a simple man of the people.

May I be permitted to tell you of a little circumstance when he hired me on an annual salary? I had been in Washington doing some shad work on the Potomac River, and he telegraphed me from Havre de Grace, I think, to report at Washington when I was through with the work. I did so, and he began the arrangement at that time of the important work now so well established on the Great Lakes. That was the first time that they ever provided or planned for the work in Michigan and arranged for a station there. I met Professor Baird on three different days. I would meet him and he would spend fifteen or twenty minutes with me, or as long as he could, and then, as of course he had other work, he would tell me to call the next day. I did so and we went on and planned out the work that is now being carried on in Michigan just as it was started; and he never said a word about what I was going to receive, or whether I was going to get anything. Up to the last day, when he shook hands with me and said, "Mr. Clark, good bye; I hope you will have a pleasant journey," there had not been a word as to finances. That shows you the kind of man Professor Baird was. I sat in his office one day when some Senators called. It was the year of a presidential election. I cannot tell you who was nominated for President; but the convention was in Chicago and those Senators talked about the nomination. Professor Baird asked if they had learned who was nominated. No, they had not. "Well," he said, "I hope they will nominate a good man—as long as they do not nominate me." He did not want anything to do with the political line of the work.

I hope you will bear with me, because this is a matter that I like to talk about.

HISTORY OF THE AMERICAN FISHERIES SOCIETY

By Ward T. Bower

To preserve, and at the same time use, the wealth contained in our lands and waters is a national problem of recent general recognition. On the horizon of forty years ago, however, stands a little group of men who were early in this field in behalf of one of the great natural resources, and largely through their efforts came the first national recognition of the cause. These men, the founders of the American Fisheries Society, were directly responsible for the inauguration of fish culture as a Government undertaking. This Society, therefore, promoter of fish culture, fish protection, and all that relates to the welfare of the fisheries, and collaborator with the United States Bureau of Fisheries and the state fishery organizations, appears among the pioneers in the great national movement we now call conservation.

When the larger significance of an organization like this is appreciated, the Society's history and specific achievements acquire a new interest. Particularly on this its fortieth anniversary, with four decades of development in the interests it has fostered, may the Society's own growth be marked and its activities be reviewed, and this the more because three-fourths of the present membership is new in the last ten years. To most of these newer members the early records and even the names of the men who made the organization are unfamiliar. These records are not, in fact, to be easily assembled. There is apparently just one complete set of the Society's Transactions in existence.

ORIGIN AND USEFULNESS

The American Fisheries Society originated as the American Fish Culturists' Association, which was formed in New York City December 20, 1870. Fish culture was comparatively new as a practical enterprise in the United

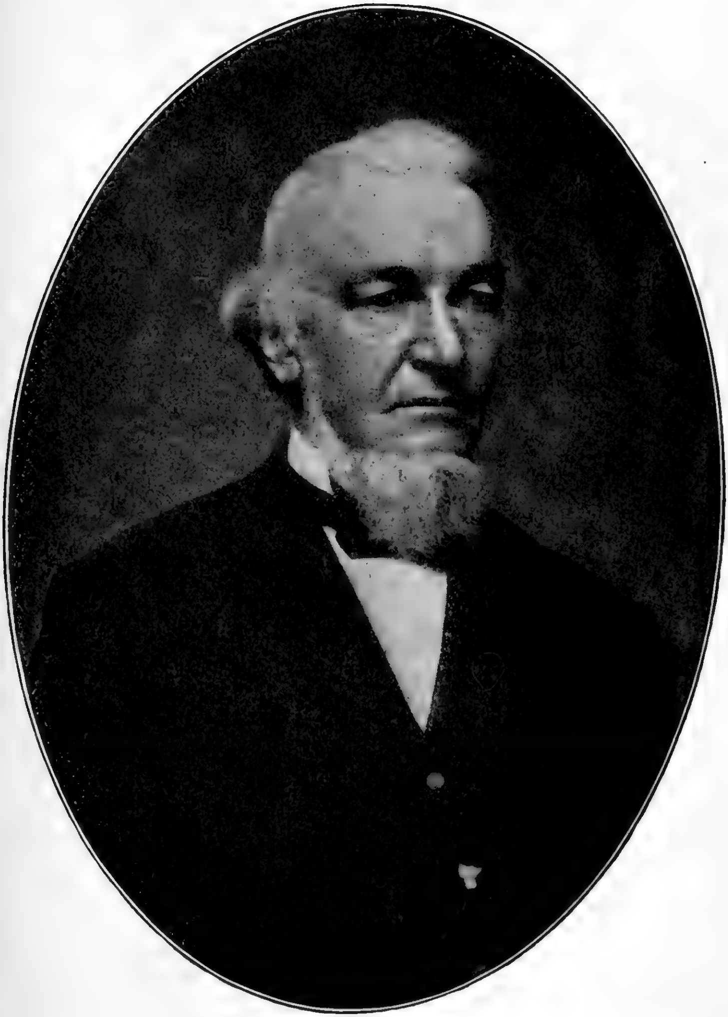
States. The term "fish culturist," it appears, meant merely a breeder of trout, for although Seth Green had been successful in hatching shad and Livingston Stone had hatched salmon in New Brunswick, the work other than with brook trout had been experimental rather than practical. Thus fish culture not only meant merely trout culture, but trout culture meant only the breeding of fontinalis or brook trout. The fish culturists who organized, therefore, were trout culturists, and their original purpose is declared in the following call:

> The undersigned, desirous of promoting the interests of fish culture, call a convention of pisciculturists, at the Skating Rink, City of New York, December 20, 1870, at 11.00 A.M.
>
> The design of the convention is consultation for the protection of our interests, and, if thought best, to organize a permanent association.
>
> MYSTIC BRIDGE, CONN., Nov. 1, 1870. (Signed)
>
> W. CLIFT,
> A. S. COLLINS,
> J. H. SLACK,
> F. MATHER,
> L. STONE.

But selfish commercial interest was never more promptly extinguished than upon the assembling of these fish culturists, for, says Mr. Stone, writing some years later,—

> As soon as the first annual meeting of the Association was held, it was apparent that its future efforts were to be directed to the promotion of the public good rather than to the furtherance of private interests. This happy change was at once cheerfully accepted by all, and the subject of regulating the tariff of prices was only once mentioned, I believe, and then dropped forever.

The public spirit which was to characterize the future of this organization appeared at its second meeting in a motion made by George Shepard Page. This motion proposed that the Association memorialize Congress to the end that the government establish two or more fish-cultural stations. The fruits which this action bore, and the part it played in molding the future of practical fish culture in the United States are expressed by Professor Spencer F. Baird, United States Fish Commissioner, in his official report for 1875-76:



William Clift

A Founder of the Society and its First President (1870-1874)

Born September 12, 1817 Died December 8, 1890

It must not be forgotten that the first authoritative suggestion of the propriety and importance of federal action in regard to the stocking of the common waters of the United States was made by this [The American Fish Culturists' Association] body, a committee having been appointed at the meeting of 1870 to memorialize Congress on the subject. The valuable counsel and advice of the officers and members of this Association have always been at the service of the United States Fish Commission, and have been made use of in many important instances.

As an organization of practical men, progressive in spirit and concerned with developing fishery fields, the Society has given to its members the benefits of mutual inspiration, encouragement and comparison of ideas. These benefits have resulted not only in new ways and means of business enterprise but in the spreading of information and doctrine which has been a factor in all of this country's progress in the development of its fisheries and their preservation.

CHANGES OF NAME

The name of American Fish Culturists' Association, the first borne by the organization, was superseded in 1878 by the modification "American Fish Cultural Association." The suggestion was made by Barnet Phillips, the idea being that the latter term seemed broader and better fitted to the enlarged scope of the organization. This name had endured for only six years, however, when in 1884 Professor Goode proposed "American Fisheries Association" as a name corresponding more precisely with similar organizations in Europe. There was some difference of opinion among the members as to the significance and propriety of the change, and Mr. Mather voiced a protesting regret of the charter members by saying: "It is like exchanging a tattered flag that we have fought under for one just out of the shop. I can readily see how new members may desire a change, but I cannot approve it." After some debate, however, by Professor Goode, Mr. Roosevelt, Colonel McDonald, Dr. Hudson, and others, an amendment by Mr. S. G. Worth substituting the word Society for Association was passed, and the organization became what it has been ever since—the American Fisheries Society.

MEMBERSHIP

Of the charter members of the Society just one is living who retains his membership today—Livingston Stone. There is apparently no list of these members extant, but their names are, no doubt, all to be found in the first membership list that was published—namely, for 1873, which it seems, therefore, of interest to reproduce here.

LIST OF MEMBERS OF THE AMERICAN FISH-CULTURISTS' ASSOCIATION IN 1873

William Clift, Mystic Bridge, Conn.
B. F. Bowles, Springfield, Mass.
Livingston Stone, Charlestown, N. H.
A. S. Collins, Caledonia, N. Y.
George Shepard Page, 10 Warren St., New York City.
Dr. Huntington, Watertown, N. Y.
Fred Mather, Honeoye Falls, N. Y.
E. W. Stoughton, Windsor, Vt.
Richards Bradley, Brattleboro, Vt.
George H. Jerome, Niles, Mich.
A. B. Crocker, Norway, Me.
Edward Whitin, Whitinsville, Mass.
Theodore Schultz, P. O. Box 3141, New York City.
T. J. Whitcomb, Springfield, Vt.
J. D. Bridgman, Bellows Falls, Vt.
Benjamin Farrar, 12 North St., St. Louis, Mo.
George Jewett, M. D., Fitchburg, Mass.
B. Frank Boyer, Reading, Pa.
A. C. Rupe, New York City.
A. B. Sprout, Muncey, Pa.
B. B. Porter, Oakland, N. J.
M. H. Chrystler, Kinderhook, N. Y.
Gifford W. Chrystler, Kinderhook, N. Y.
E. Sterling, M. D., Cleveland, Ohio.
F. J. Chandler, Alstead, N. H.
Seth Green, Rochester, N. Y.
C. H. Farnham, Milton, N. Y.
Arthur Maginnis, Stanhope, Pa.
James Worrall, Harrisburg, Pa.
E. B. Paxton, Detroit, Mich.
A. P. Rockwood, Salt Lake City, Utah.
Joseph Van Cleve, 46 Franklin St., Newark, N. J.
Phil. Neidlinger, 10 William St., New York City.
Dr. W. H. Newell, President of the Society of Acclimatization, San Francisco, Cal.

HONORARY MEMBERS

Prof. Spencer F. Baird, U. S. Commissioner of Fisheries, Washington, D. C.

Albert S. Bickmore, Superintendent American Museum of Natural History, New York City.

Samuel Wilmot, Newcastle, Ontario, Canada.

There are 25 names now on the rolls which were there twenty years ago or more, as shown by the following list:

Livingstone Stone	1870	Charter member.
Albert S. Bickmore	1872	Elected honorary 1872, active 1884.
Theodore Gill	1875	Reelected in 1904.
James Annin	1878	
Caleb Haley	1878	
S. M. Johnston	1879	
Perry Belmont	1880	
Charles Mallory	1880	
Charles G. Atkins	1884	
Tarleton H. Bean	1884	Reelected in 1902.
Frank N. Clark	1884	
James A. Henshall	1884	
W. L. May	1884	
Richard Rathbun	1884	Reelected in 1888 and 1889.
S. G. Worth	1884	
S. P. Bartlett	1886	
James Nevin	1886	
John H. Bissell	1886	
Calvert Spensley	1887	
J. J. Stranahan	1888	Reelected 1890.
H. O. Wilbur	1889	
R. M. Hartley	1889	
Edwin Hagert	1889	
Seymour Bower	1890	
John E. Gunckel	1890	

Corresponding memberships were created in 1884, upon the suggestion of Mr. Mather. This proposition contemplated the enlistment of foreign officials and others distinguished in fishery affairs for the purpose of interchange of reports and ideas. Colonel McDonald endorsed the plan, and proposed that such corresponding members be exempt from fees of all sorts. The resolution was adopted and 21 corresponding members whose names were submitted by Colonel McDonald were at once elected.

The regular membership of the Society has increased with comparative steadiness, showing a gain of over 100 between 1890 and 1900, and a net growth of more than 200 from 1900 to 1910. Additions numbering 68 in 1900, 72 in 1903, and 56 in 1908 were the largest in any given year until the present, when the new names enrolled will number over 130.

PLACES OF MEETING

Of the forty meetings already held, including the special meeting in 1876, all but ten have been in the east, and of the eastern meetings fifteen have occurred in New York City. The first meeting of the Society was held in New York City in the rooms of the New York Poultry Society, the second at the Globe Hotel in Albany. The next four meetings, from 1873 to 1876, inclusive, were held at the office of George Shepard Page, 10 Warren St., New York City. Then followed the extra meeting in connection with the Centennial celebration at Philadelphia in 1876. From 1877 to 1883, inclusive, the meetings were held in New York, the first of this series at the Aquarium, and those succeeding at the rooms of the Directors of the Fulton Market Fishmongers' Association, until the 1883 meeting which was held at the Cooper Institute. In 1884, 1885, and 1891, the place of meeting was the National Museum, Washington, D. C. In 1908 the Society once more went to Washington, with headquarters at the Arlington Hotel. This meeting was in connection with the assembling of the Fourth International Fisheries Congress, which brought a number of the Society's members from foreign countries. Other eastern meeting places have been Philadelphia, Pa.; Woods Hole, Mass.; Atlantic City, N. J.; White Sulphur Springs, W. Va., and Erie, Pa.

The first western meeting was at Chicago in 1886. There were some misgivings that a meeting so far west would not be well attended or advantageous to the Society. The gathering was, however, a success in every way, and Chicago was again selected as a place of meeting in 1893. In 1898 the Society went to Omaha, Neb., the most westerly point of meeting so far in its history. Twice it met at Detroit, Mich., in 1888 and again in 1897, and twice at

George Shepard Page

A Founder of the Society, Vice-President 1874-1881 and 1883-1884, President 1882-1883

Put-in Bay, Ohio, in 1890 and in 1902. Other western points of meeting have been Milwaukee, Wis., 1901, and Grand Rapids, Mich., 1906.

DUES

The Society's financial resources consist of the annual membership dues and the almost negligible receipts from the sale of reports.

At the time of organization in 1870 the annual membership fee was placed at $3.00. This continued only until 1872, when it was increased to $5.00. In 1875 the dues were again reduced to $3.00, which rate prevailed until 1898, when, there being over $400.00 in the Treasury, the fee was reduced to $1.00 per annum. In 1898 the life membership fee of $15.00 was also established. In 1904 an amendment changed the annual dues to $2.00, and the life membership fee to $25.00, which rates have since been in force. The increase in 1904 was made necessary because during the preceding six years at a one dollar rate the treasury surplus of over $400.00 had become a deficit of $46.50. By 1907, however, there was a balance on the right side of the ledger, which, though it disappeared in a small deficit the next year, became a resource of nearly $300.00 in 1909.

The yearly balances and deficits in the treasury may have sufficient interest to warrant their inclusion here.

REPORTS OF TREASURER

No report prior to 1873.

Feb. 11, 1873	B. F. Bowles,	bal. on hand	$29.08
" 10, 1874	"	"	18.83
" 9, 1875	"	"	72.58
1876	"	"	
" 8, 1877	Eugene G. Blackford,	bal. on hand	76.39
" 27, 1878	"	bal. due Treasurer	123.50
" 25, 1879	"	"	232.25
Mar. 30, 1880	"	"	131.70
" 30, 1881	"	"	26.73
Apr. 3, 1882	"	"	57.26
June 7, 1883	"	"	89.55
May 18, 1884	"	bal. on hand	187.25

May 12, 1885	Eugene G. Blackford,	bal. due Treasurer	$102.58
Apr. 9, 1886	"	bal. on hand	37.63
May 30, 1887	"	bal. due Treasurer	80.17
" 10, 1888	"	bal. on hand	61.65
" 10, 1889	"	bal. due Treasurer	5.29
" 12, 1890	Henry C. Ford,	bal. on hand	76.85
" 26, 1891	"	"	98.87
" 24, 1892	"	"	217.73
June 1, 1893	"	"	66.86
May 14, 1894	Dr. R. Ormsby Sweeny,	bal. on hand	67.49
June 12, 1895	Frank J. Amsden,	bal. on hand	64.06
May 20, 1896	"	"	141.32
June 15, 1897	L. D. Huntington,	bal. on hand	327.77
July 12, 1898	"	"	401.26
June 26, 1899	"	"	294.56
July 18, 1900	"	"	216.34
" 15, 1901	C. W. Willard,	bal. on hand	165.09
Aug. 5, 1902	"	"	101.14
July 21, 1903	"	"	62.65
" 26, 1904	"	bal. due Treasurer	46.50
" 25, 1905	"	"	111.87
" 24, 1906	"	"	26.78
" 23, 1907	"	bal. on hand	131.32
Sept. 21, 1908	"	bal. due Treasurer	42.45
July 27, 1909	"	bal. on hand	292.05

PUBLICATION OF REPORTS AND PAPERS

The publications of the American Fisheries Society are a valuable contribution to fishery literature, and especially to fish-cultural literature. The membership has always numbered in its ranks the men foremost in all fishery affairs, and their contributions are of corresponding authority. In fish culture, which has been the predominating subject, the papers presented before the Society are in effect a record of the progress of this practical science from its first inception in America. The habits of fishes, fish diseases, pollution of waters, fishing methods and fishing industries, angling, the shellfish and lobster fisheries, fish protection and administrative methods—these subjects and various aspects of each are represented in the contents of the Society's reports.

The reports of the first two meetings, in 1870 and 1872, were combined in a single document, but the Transactions have since appeared annually. Thus in the Society's forty years of existence there have been thirty-eight separate reports, and these have comprised more than five thousand pages and 432 papers and addresses.

Some confusion as to the correlation of meetings and the published reports of the Society has led to complication in the numbering of the reports which has but recently been set right. The report of the organization meeting in New York City December 20, 1870, was published in 1872 together with the proceedings of the second meeting held at Albany February 7 and 8 of that year. This combined report, however, was called the first, and until 1909 each succeeding annual report has been numbered consecutively from this beginning. Thus the 1908 report was made to refer to the thirty-seventh meeting, but the last, or 1909, report was properly designated as the Transactions of the thirty-ninth meeting. This does not take into account the special meeting at Philadelphia in 1876, to which a few pages of the 1877 report are devoted.

For a period beginning in 1874, *Forest and Stream,* founded a year previously, was the official organ of the Society, with the privilege of printing the papers presented at the meetings and elsewhere published only in the official reports. Objection on the part of other journals to this exclusive privilege occasioned considerable debate at the 1888 meeting and ultimately led to a more liberal attitude on this subject.

The officially published Transactions have always been free to members. Some discussion of this matter occurred in 1888, but the proposition to sell current reports was discountenanced. Back numbers, it was decided in 1900, should be sold at 25 cents per copy, a price which in 1905 was increased to 50 cents.

Successive recommendations and actions by the Society have effected improvement in style and form of the Transactions, which are now published under the direction of a standing editorial committee.

CONSTITUTION AND AMENDMENTS

Following is a copy of the original constitution, as drafted by Livingston Stone and Dr. W. M. Edmonds, together with the various amendments adopted from time to time; also notes on the general revision of the constitution in 1886:

ARTICLE I
Name and Objects

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

ARTICLE II
Members

All fish culturists shall, upon a two-thirds vote of the Society and a payment of three dollars, be considered members of the Association, after signing the constitution. The commissioners of the various states shall be honorary members of the Association, *ex officio*.

ARTICLE III
Officers

The officers of the Association shall be a President, a Secretary and a Treasurer, and shall be elected annually by a majority vote. Vacancies occurring during the year may be filled by the President.

ARTICLE IV
Meetings

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

ARTICLE V
Changing the Constitution

The constitution of the society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting.

AMENDMENTS
First Amendment

"On motion of Mr. Livingston Stone the constitution was amended by striking out the word 'and' after the word 'secretary' in Art. III, and inserting after the word 'treasurer' the words 'and an executive committee of three members.'" (1872, p. 10.)

Second Amendment

"On motion of Mr. A. S. Collins, it was resolved that the initiatory and annual assessment be increased to five dollars." (1872, p. 11.)

Third Amendment

"On motion of Mr. F. Mather, the constitution was so amended that the list of officers should include a Vice-President." (1874, p. 3.)

Fourth Amendment

"Mr. H. J. Reeder moved that the Constitution be amended by striking out the last paragraph of Art. II. Carried." The clause thus removed was the following: "The commissioners of the various states shall be honorary members of the Association, *ex officio*." (1874, p. 5.)

Fifth Amendment

"On motion of Mr. George Shepard Page the executive committee was made to consist of five." (1874, p. 5.)

Sixth Amendment

"Mr. George Shepard Page moved to amend Art. II by striking out the words 'all fish culturists,' and inserting the words 'any person.' Carried." (1874, p. 5.)

Seventh Amendment

"Mr. Page moved that Art. II of the Constitution be amended by making the annual dues $3. Carried." (1875, p. 4.)

Eighth Amendment

Mr. Barnet Phillips moved "That the name of the American Fish Culturists' Association be changed, and that of the American Fish Cultural Association be adopted."

It was urged by Mr. Phillips that the former title was a limited one, while the proposed change admitted of greater scope. The resolution was adopted. (1878, p. 76.)

Ninth Amendment

Mr. Phillips, the Secretary, proposed that the number of the Executive Committee be increased to seven members. Resolution adopted. (1878, p. 76.)

(A footnote at the end of the Transactions for 1878, page 118, says: "In changing the name of the Association from Fish Culturists' to Fish Cultural, the Secretary proposed that in the Constitution, after the final word fish culturists, the following be added: 'and the treatment of all questions regarding fish of a scientific and economic character.' This change and addition to the Constitution was adopted.")

Tenth Amendment

"Mr. Phillips moved for an amendment to Article III of the Constitution, so as to include a Recording Secretary, which was carried." (1879, p. 50.)

Eleventh Amendment

"Mr. Mather proposed an amendment to the Constitution to permit honorary members to be elected by a two-thirds vote, the same to be added to the Constitution as a part of Article II, relative to members, and to read as follows: 'Any person shall, upon a two-thirds vote of the Society, be considered as an honorary member of the Association.'" Adopted. (1881, p. 3.)

Twelfth Amendment

Mr. Evarts moved to amend Article III relating to the election of officers by making the offices of President and Vice-President, vacant after one year, and those holding them ineligible for the same office until after an interval of one year. Adopted. (1882, p. 4.)

Thirteenth Amendment

Upon motion of Professor Goode as amended by Mr. Roosevelt it was decided to change the name of the organization from the American Fish Cultural Association to the American Fisheries Society. (1884, p. 230-238.)

REVISION OF CONSTITUTION

On motion of Mr. Mather, recording secretary, a committee of three, consisting of Messrs. Fred Mather, W. V. Cox and F. N. Clark, was appointed to revise the constitution and prepare by-laws. The committee offered a proposed constitution for consideration until the next meeting. This tentative form was printed in the proceedings for 1885, pages 3 to 7.

On motion of Mr. Bissell, duly seconded, at the meeting April 14, 1886, each article of the proposed constitution was taken up and separately acted upon. (1886, p. 24.)

Following is a copy of the revised and accepted constitution:

ARTICLE I

Name and Objects

The name of this Society shall be "The 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 the interests of fish-culture and the fisheries; and the treatment of all questions regarding fish, of a scientific and economic character.

ARTICLE II

Members

Any person shall, upon a two-thirds vote and the payment of three dollars, become a member of this Society. In case members do not pay their fees which shall be three 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

Fred Mather

A Founder of the Society, Recording Secretary 1883-1889
Vice-President 1892-1894

Born August 2, 1833 Died February 14, 1900

membership. Any person can be made an honorary or a corresponding member upon a two-thirds vote of the members present at any regular meeting.

ARTICLE III

Officers

The officers of this Society shall be a President and a Vice-President, who shall be ineligible for election to the same offices until a year after the expiration of their terms, a Corresponding Secretary, a Recording Secretary, a Treasurer, and an Executive Committee of seven, which with the officers before named, shall form a council and transact such business as may be necessary when the Society is not in session, four to constitute a quorum.

ARTICLE IV

Meetings

The regular meeting of the Society shall be held once a year, the time and place being decided upon at the previous meeting, or in default of such action, by the Executive Committee.

ARTICLE V

Changing the Constitution

The Constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting, provided, at least fifteen members are present at said meeting.

First Amendment to Revised Constitution

In 1898 Article II was amended by making the annual dues one dollar instead of three dollars. (1898, p. 16.)

Second Amendment to Revised Constitution

Article II was amended in 1900 by adding the following provision:

Any person shall, upon a two-thirds vote, and the payment of $15.00, become a life member of this Society, and shall thereafter be exempt from all annual dues. (1900, p. 19-20.)

Third Amendment to Revised Constitution

In 1902 the following order of business was provided for and made Article V, the original Article V becoming Article VI. (1902, p. 26-27.)

Order of Business

1. Call to order by President.
2. Roll call of members.
3. Applications for membership.
4. Reports of officers.
   a. President.
   b. Secretary.
   c. Treasurer.
   d. Standing committees.
5. Committees appointed by President.
   a. Committee of five on nomination of officers for ensuing year.

b. Committee of three on time and place of next meeting.
c. Auditing committee of three.

6. Reading of papers and discussions of same.
   (Note—a. In the reading of papers preference shall be given to members present.
   b. The President and two Secretaries are empowered to arrange the papers of the meetings of the Society.)
7. Miscellaneous business.
8. Adjournment.

Fourth Amendment to Revised Constitution

In 1904 Article II was amended making the annual dues two dollars instead of one dollar. (1904, p. 22.)

Fifth Amendment to Revised Constitution

In 1904 Article II was amended by making the life membership fee twenty-five dollars instead of fifteen dollars. (1904, p. 15.)

Sixth Amendment to Revised Constitution

In 1909 Article III was amended by inserting after the words "recording secretary" the words "assistant recording secretary." (1909, p. 16-17.)

From the foregoing it will be noted that there were thirteen amendments up to the time the revised constitution was adopted in 1886, and six amendments since its revision.

OFFICERS OF THE SOCIETY FROM ORGANIZATION TO DATE

1870-1872

William Clift, Pres., Mystic Bridge, Conn.
Livingston Stone, Secy., Charleston, N. H.
B. F. Bowles, Treas., Springfield, Mass.

1872-1873

William Clift, Pres., Mystic Bridge, Conn.
Livingston Stone, Secy., Charleston, N. H.
B. F. Bowles, Treas., Springfield, Mass.

1873-1874

William Clift, Pres., Mystic Bridge, Conn.
A. S. Collins, Secy., Caledonia, N. Y.
B. F. Bowles, Treas., Springfield, Mass.

1874-1875

Robert B. Roosevelt, Pres., New York, N. Y.
George Shepard Page, V. Pres., New York, N. Y.
A. S. Collins, Secy., Caledonia, N. Y.
B. F. Bowles, Treas., Springfield, Mass.

1875-1876

Robert B. Roosevelt, Pres., New York, N. Y.
George Shepard Page, V. Pres., New York, N. Y.
A. S. Collins, Secy., Caledonia, N. Y.
B. F. Bowles, Treas., Springfield, Mass.

1876-1877

Robert B. Roosevelt, New York, N. Y.
George Shepard Page, V. Pres., New York, N. Y.
Eugene G. Blackford, Treas., New York, N. Y.
M. C. Edmunds, Secy., Weston, Vt.

1877-1878

Robert B. Roosevelt, Pres., New York, N. Y.
George Shepard Page, V. Pres., New York, N. Y.
Eugene G. Blackford, Treas., New York, N. Y.
Barnet Phillips, Secy., Brooklyn, N. Y.

1878-1879

Robert B. Roosevelt, Pres., New York, N. Y.
George Shepard Page, V. Pres., New York, N. Y.
Eugene G. Blackford, Treas., New York, N. Y.
Barnet Phillips, Secy., Brooklyn, N. Y.

1879-1880

Robert B. Roosevelt, Pres., New York, N. Y.
George Shepard Page, V. Pres., New York, N. Y.
Eugene G. Blackford, Treas., New York, N. Y.
Barnet Phillips, Cor. Secy., Brooklyn, N. Y.
James Annin, Jr., Rec. Secy., Caledonia, N. Y.

1880-1881

Robert B. Roosevelt, Pres., New York, N. Y.
George Shepard Page, V. Pres., New York, N. Y.
Eugene G. Blackford, Treas., New York, N. Y.
Barnet Phillips, Cor. Secy., Brooklyn, N. Y.
James Annin, Jr., Rec. Secy., Caledonia, N. Y.

1881-1882

Robert B. Roosevelt, Pres., New York, N. Y.
George Shepard Page, V. Pres., New York, N. Y.
Eugene G. Blackford, Treas., New York, N. Y.
Barnet Phillips, Cor. Secy., Brooklyn, N. Y.
James Annin, Jr., Rec. Secy., Caledonia, N. Y.

1882-1883

George Shepard Page, Pres., New York, N. Y.
James Benkard, V. Pres., New York, N. Y.

Eugene G. Blackford, Treas., New York, N. Y.
Barnet Phillips, Cor. Secy., Brooklyn, N. Y.
James Annin, Jr., Rec. Secy., Caledonia, N. Y.

1883-1884

James Benkard, Pres., New York, N. Y.
George Shepard Page, V. Pres., New York, N. Y.
Eugene G. Blackford, Treas., New York, N. Y.
Barnet Phillips, Cor. Secy., Brooklyn, N. Y.
Fred Mather, Rec. Secy., New York, N. Y.

1884-1885

Theodore Lyman, Pres., Brookline, Mass.
Marshall McDonald, V. Pres., Washington, D. C.
Eugene G. Blackford, Treas., New York, N. Y.
R. Edward Earll, Cor. Secy., Washington, D. C.
Fred Mather, Rec. Secy., New York, N. Y.

1885-1886

Marshall McDonald, Pres., Berryville, Va.
Dr. W. M. Hudson, V. Pres., Hartford, Conn.
Eugene G. Blackford, Treas., Brooklyn, N. Y.
Fred Mather, Rec. Secy., Cold Spring Harbor, N. Y.
W. V. Cox, Cor. Secy., Washington, D. C.

1886-1887

W. M. Hudson, Pres., Hartford, Conn.
W. L. May, V. Pres., Fremont, Nebr.
Eugene G. Blackford, Treas., Brooklyn, N. Y.
Fred Mather, Rec. Secy., Cold Spring Harbor, N. Y.
W. A. Butler, Jr., Cor. Secy., Detroit, Mich.

1887-1888

William L. May, Pres., Fremont, Nebr.
H. H. Cary, V. Pres., Cold Spring Harbor, N. Y.
W. A. Butler, Jr., Cor. Secy., Detroit, Mich.
Eugene G. Blackford, Treas., Brooklyn, N. Y.
Fred Mather, Rec. Secy., Cold Spring Harbor, N. Y.

1888-1889

John H. Bissell, Pres., Detroit, Mich.
S. G. Worth, V. Pres., Washington, D. C.
Fred Mather, Rec. Secy., Cold Spring Harbor, N. Y.
Henry C. Ford, Cor. Secy., Philadelphia, Pa.
Eugene G. Blackford, Treas., Brooklyn, N. Y.

1889-1890

Eugene G. Blackford, Pres., New York, N. Y.
Herschel Whitaker, V. Pres., Detroit, Mich.

Henry C. Ford, Treas., Philadelphia, Pa.
Frederic W. Brown, Rec. Secy., Philadelphia, Pa.
C. V. Osborn, Cor. Secy., Dayton, O.

1890-1891

Eugene G. Blackford, Pres., New York, N. Y.
James A. Henshall, V. Pres., Cincinnati, O.
Henry C. Ford, Treas., Philadelphia, Pa.
Edward P. Doyle, Rec. Secy., New York, N. Y.
Tarleton H. Bean, Cor. Secy., Washington, D. C.

1891-1892

Jas. A. Henshall, Pres., Cincinnati, Ohio.
J. C. Parker, V. Pres., Grand Rapids, Mich.
Henry C. Ford, Treas., Philadelphia, Pa.
Edward P. Doyle, Rec. Secy., New York, N. Y.
Tarleton H. Bean, Cor. Secy., Washington, D. C.

1892-1893

Herschel Whitaker, Pres., Detroit, Mich.
Fred Mather, V. Pres., Cold Spring Harbor, N. Y.
Henry C. Ford, Treas., Philadelphia, Pa.
Edward P. Doyle, Rec. Secy., New York, N. Y.
Tarleton H. Bean, Cor. Secy., Washington, D. C.

1893-1894

Henry C. Ford, Pres., Philadelphia, Pa.
Fred Mather, V. Pres., Cold Spring Harbor, N. Y.
R. Ormsby Sweeney, Treas., Duluth, Minn.
Edward P. Doyle, Rec. Secy., New York, N. Y.
James A. Henshall, Cor. Secy., Cincinnati, O.

1894-1895

William L. May, Pres., Fremont, Nebr.
R. Ormsby Sweeney, V. Pres., Duluth, Minn.
Frank J. Amsden, Treas., Rochester, N. Y.
Edward P. Doyle, Rec. Secy., Port Richmond, N. Y.
James A. Henshall, Cor. Secy., Cincinnati, O.

1895-1896

L. D. Huntington, Pres., New Rochelle, N. Y.
Calvert Spensley, V. Pres., Mineral Point, Wis.
Frank J. Amsden, Treas., Rochester, N. Y.
Tarleton H. Bean, Rec. Secy., New York, N. Y.
H. B. Mansfield, U. S. N., Cor. Secy., Brooklyn, N. Y.

1896-1897

Herschel Whitaker, Pres., Detroit, Mich.
Bushrod W. James, V. Pres., Philadelphia, Pa.

L. D. Huntington, Treas., New Rochelle, N. Y.
A. Nelson Cheney, Rec. Secy., Glens Falls, N. Y.
H. B. Mansfield, U. S. N., Cor. Secy., Brooklyn, N. Y.

1897-1898

William L. May, Pres., Omaha, Nebr.
George F. Peabody, V. Pres., Appleton, Wis.
L. D. Huntington, Treas., New Rochelle, N. Y.
Herschel Whitaker, Rec. Secy., Detroit, Mich.
John E. Gunckel, Cor. Secy., Toledo, Ohio.

1898-1899

George F. Peabody, Pres., Appleton, Wis.
William H. Bowman, V. Pres., Rochester, N. Y.
Herschel Whitaker, Rec. Secy., Detroit, Mich.
John E. Gunckel, Cor. Secy., Toledo, Ohio.
L. D. Huntington, Treas., New Rochelle, N. Y.

1899-1900

John W. Titcomb, Pres., St. Johnsbury, Vt.
Henry T. Root, V. Pres., Providence, R. I.
L. D. Huntington, Treas., New Rochelle, N. Y.
Seymour Bower, Rec. Secy., Detroit, Mich.
John E. Gunckel, Cor. Secy., Toledo, Ohio.

1900-1901

F. B. Dickerson, Pres., Detroit, Mich.
E. E. Bryant, V. Pres., Madison, Wis.
C. W. Willard, Treas., Westerly, R. I.
Seymour Bower, Rec. Secy., Detroit, Mich.
W. de C. Ravenel, Cor. Secy., Washington, D. C.

1901-1902

E. E. Bryant, Pres., Madison, Wis.
Eugene G. Blackford, V. Pres., New York, N. Y.
George F. Peabody, Rec. Secy., Appleton, Wis.
John E. Gunckel, Cor. Secy., Toledo, Ohio.
C. W. Willard, Treas., Westerly, R. I.

1902-1903

George M. Bowers, Pres., Washington, D. C.
Henry B. Ward, V. Pres., Lincoln, Nebr.
George F. Peabody, Rec. Secy., Appleton, Wis.
John E. Gunckel, Cor. Secy., Toledo, Ohio.
C. W. Willard, Treas., Westerly, R. I.

1903-1904

Frank N. Clark, Pres., Northville, Mich.
Tarleton H. Bean, V. Pres., St. Louis, Mo.

George F. Peabody, Rec. Secy., Appleton, Wis.
W. de C. Ravenel, Cor. Secy., Washington, D. C.
C. W. Willard, Treas., Westerly, R. I.

1904-1905

Henry T. Root, Pres., Providence, R. I.
C. D. Joslyn, V. Pres., Detroit, Mich.
George F. Peabody, Rec. Secy., Appleton, Wis.
Charles G. Atkins, Cor. Secy., E. Orland, Me.
C. W. Willard, Treas., Westerly, R. I.

1905-1906

C. D. Joslyn Pres., Detroit, Mich.
Hugh M. Smith, V. Pres., Washington, D. C.
George F. Peabody, Rec. Secy., Appleton, Wis.
Charles G. Atkins, Cor. Secy., E. Orland, Me.
C. W. Willard, Treas., Westerly, R. I.

1906-1907

E. A. Birge, Pres., Madison, Wis.
Hugh M. Smith, V. Pres., Washington, D. C.
George F. Peabody, Rec. Secy., Appleton, Wis.
Charles G. Atkins, Cor. Secy., E. Orland, Me.
C. W. Willard, Treas., Westerly, R. I.

1907-1908

Hugh M. Smith, Pres., Washington, D. C.
Tarleton H. Bean, V. Pres., New York, N. Y.
George F. Peabody, Rec. Secy., Appleton, Wis.
Charles G. Atkins, Cor. Secy., E. Orland, Me.
C. W. Willard, Treas., Westerly, R. I.

1908-1909

Tarleton H. Bean, Pres., Albany, N. Y.
Seymour Bower, V. Pres., Detroit, Mich.
George F. Peabody, Rec. Secy., Appleton, Wis.
Charles G. Atkins, Cor. Secy., E. Orland, Me.
C. W. Willard, Treas., Westerly, R. I.

1909-1910

Seymour Bower, Pres., Detroit, Mich.
William E. Meehan, V. Pres., Harrisburg, Pa.
George F. Peabody, Rec. Secy., Appleton, Wis.
Ward T. Bower, Asst. Rec. Secy., Washington, D. C.
Charles G. Atkins, Cor. Secy., E. Orland, Me.
C. W. Willard, Treas., Westerly, R. I.

STATISTICAL REVIEW OF MEETINGS, MEMBERSHIP AND REPORTS

Date of Meeting	Place		Members Present	Total Membership	Number Papers Pres'n'ed	Pages in Report
December 20, 1870	New York City	Rooms of New York Poultry Society	7*a*	—	—	—
February 7-8, 1872	Albany, N. Y.	Globe Hotel	11*b*	—	5	56
February 11, 1873	New York City	Office Geo. Shepard Page, 10 Warren St.	9	37	7	34
February 10, 1874	New York City	do	—	61	6	48
February 9-10, 1875	New York City	do	30	75	6	43
February 8, 1876	New York City	do	—	78	2	20
October 6-7, 1876	Philadelphia, Pa.	Judges' Hall, Centennial Grounds	15	—	1	
February 14-15, 1877	New York City	New York Aquarium	—	87	6	131
February 27-28, 1878	New York City	Directors' Rooms of Fulton Market Fishmongers' Association	—	109	8	124
February 25-26, 1879	New York City	do	—	154	11	66
March 30-31, 1880	New York City	do	—	195	10	73
March 30-31, 1881	New York City	do	20	147	9	136
April 3-4, 1882	New York City	do	—	163	8	157
June 6-7, 1883	New York City	Cooper Institute	—	164	11	83
May 13-14, 1884	Washington, D. C.	National Museum	16*c*	147	22	253
May 5-6, 1885	Washington, D. C.	do	—	173	15	106
April 13-14, 1886	Chicago, Ill.	Palmer House	—	175	9	100
May 31-June 1, 1887	Washington, D. C.	National Museum	—	176	8	72
May 15-16, 1888	Detroit, Mich.	Elks Hall	—	173	10	115
May 15-16, 1889	Philadelphia, Pa.	Rooms of Anglers' Asso. of Eastern Pa.	15	196	5	87
May 14, 1890	Put-in Bay, [O.	Beebee House	—	205	14	122
May 27-28, 1891	Washington, D. C.	National Museum.	—	218	8	69
May 25-26, 1892	New York City	Holland House.	48	253	20	196
July 15-16, 1893	Chicago, Ill.	Michigan State Exposition Building	40	266	13	178
May 16-17, 1894	Philadelphia, Pa.	Rooms of Pennsylvania Fish Prot. Asso.	30	284	10	128
June 12-13, 1895	New York City	New York Aquarium	19	275	11	123
May 20-21, 1896	New York City	do	25	178	8	153
June 17-19, 1897	Detroit, Mich	Russell House	25	1 89	9	136
July 21-23, 1898	Omaha, Nebr.	Hotel Millard	15	191	14	140
June 28-29, 1899	Niagara Falls, N. Y.	International Hotel	24	218	9	107
July 18-20, 1900	Woods Hole, Mass.	United States Fisheries Station	40	323	16	192
July 19-20, 1901	Milwaukee, Wis.	Hotel Pfister.	—	370	14	173
August 5-7, 1902	Put-in Bay, O.	Hotel Victory	42	410	11	171
ly 21-23, 1903	Woods Hole, Mass.	United States Fisheries Station	58	461	14	237
July 26-28, 1904	Atlantic City, N. J.	Young's Hotel	68	536	17	264
July 25-27, 1905	White Sulphur Springs, W. Va.	White Sulphur Springs Hotel	54	517	22	284
July 24-26, 1906	Grand Rapids, Mich.	Board of Trade Building	48	473	16	254
July 23-25, 1907	Erie, Pa.	Reed Hotel	42	469	17	271
Sept'ber 21-23, 1908	Washington, D. C.	Arlington Hotel	90	516	13	195
July 27-28, 1909	Toledo, O.	Hotel Secor	41	501	17	223
					432	5320

(*a*) Not clearly shown; 7 or more present. (*b*) Not clearly shown; 11 or more present. (*c*) List gives 16 persons and says others were in attendance.

LIST, BY AUTHORS, OF PAPERS AND ADDRESSES PRESENTED FROM 1870 TO 1909

Eugene G. Blackford

Commissioner of Fisheries of New York 1878-1891, President of the Society 1889-1891

Born 1839 Died December 29, 1904

Collins, J. W.,
Result of the introduction of gill nets into the American cod fisheries ... 1884, p. 212-228
The fisheries at the World's Fair ... 1891, p. 33-41 (2 plates)
The Norwegian fisheries ... 1893, p. 60- 70
The fisheries exhibit at the World's Fair ... 1893, p. 122-129
Address ... 1894, p. 84- 92

Cole, Leon J.,
The status of the carp in America ... 1905, p. 201-206

Cox, S. S.,
Address on various aspects of fishing and the fisheries ... 1884, p. 91-109

Cox, William van Zant,
A glance at Billingsgate ... 1885, p. 76- 85
Transporting fish in the British Isles ... 1886, p. 56- 58

Dean, H. D.,
Discouragements in bass culture ... 1902, p. 153-155

De Bellesme, Jousset,
New method of pond culture (translated from the French by Dr. Tarleton H. Bean) ... 1896, p. 69- 87

Dennis, Oregon Milton,
Fish protection ... 1905, p. 133-138
The necessity of the State making laws for the protection of food fishes after stocking waters by the State or United States ... 1907, p. 103-104
Some reasons for failure of fish protective legislation and some suggestive remedies ... 1908, p. 152-156

Dickerson, F. B.,
The protection of fish and a closed season ... 1898, p. 32- 46

Dinsmore, A. H.,
Maine and the sportsman ... 1901, p. 159-162
Yellowstone Park as a national fishing resort ... 1905, p. 195-198

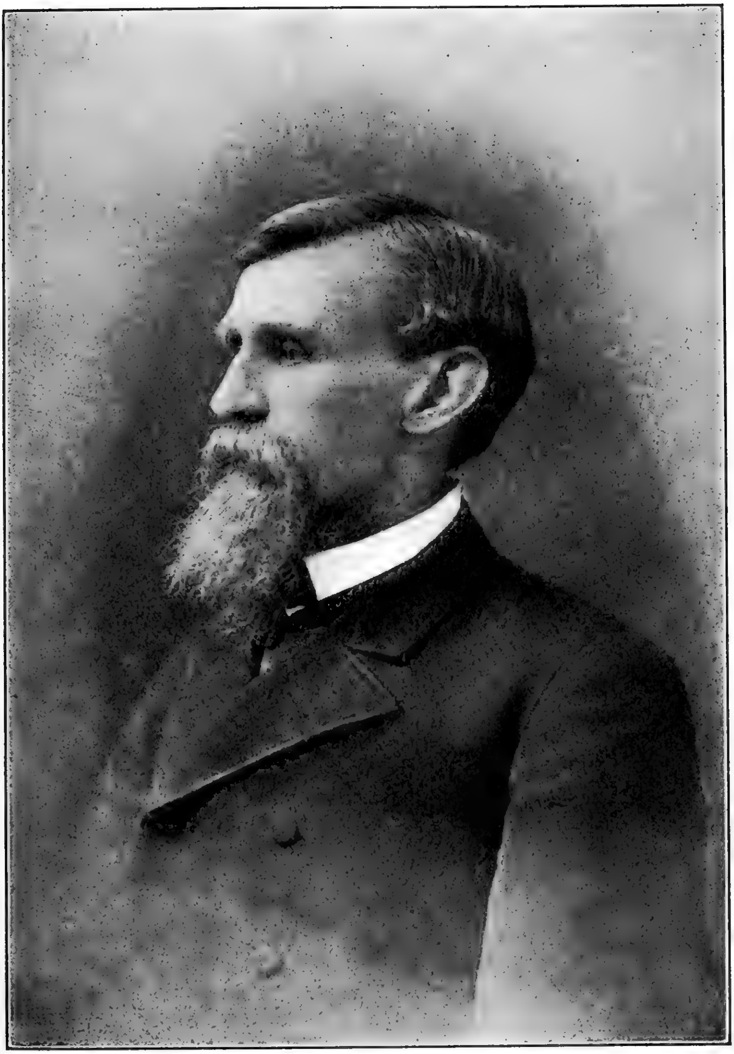
Dodge, Charles Wright,
Fish fungus at Caledonia ... 1895, p. 109-112

Downing, S. W.,
Propagation of the Pacific salmon ... 1900, p. 154-158
The whitefish; some thoughts on its propagation and protection ... 1904, p. 104-110
Collecting, hatching and distribution of pike perch; why the great loss of eggs ... 1905, p. 239-246

Dykeman, J. R.,
On the impregnation of trout eggs ... 1873, p. 13- 15

Earll, R. Edward,
State fish commissioners ... 1887, p. 23- 28

Edmonds, M. C.,
The introduction of salmon into American waters ... 1872, p. 32- 39



Marshall McDonald

Commissioner of Fisheries of Virginia 1878-1887, U. S. Commissioner of Fisheries 1888-1895, President of the Society 1885-1886

Born October 18, 1835 Died September 1, 1895

PROTECTING THE LOBSTER

By Francis H. Herrick

The true condition of the lobster fishery cannot be determined from reports upon single regions or for single years. When long periods are considered the statistics as a whole present the clearest evidence of decline. In deciding the question of actual increase or decrease in the lobster, certain variables must be duly considered; yet, it is these highly important variable factors which are apt to be neglected. To state that more lobsters were captured one season than another, without a knowledge of the conditions under which these catches were made, affords no reliable basis for determining the true state of the fishery. We need to know also the numbers of men engaged, and of traps used, as well as the character of the areas fished, and the size of the animals caught.

The lobster fisheries of Canada, next to those of the codfish and salmon, are most valuable to the Dominion, and from 1869 to 1906 inclusive yielded a grand total of $83,291,553. In 1897 the product of this industry was estimated at 23,721,554 pounds, with a value of $3,485,265. In 1906, ten years later, in spite of rising prices, the yield had dropped to 20,241,764 pounds, but though less than at the earlier time by nearly three and one half million pounds, this quantity had nearly the same value, namely, $3,422,927. The greatest yield of this fishery is recorded for the years 1885 to 1887, in 1886 reaching approximately 34,000,000 pounds, these quantities in all cases representing the meat preserved in cans, and the animals shipped alive.

This great fishery has much to hope for in propagative measures of the right sort, and all persons the world over who like lobsters should welcome every sign of its actual increase. At the same time we should wish to know the truth of the matter, and a long memory is necessary.

The produce of the Maine lobster fishery for 1907 is stated to have been between 8,000,000 and 9,000,000 pounds of lobsters 10½ inches and over in length. This seems a large quantity, but if we go back fifteen years, to 1892, we find that it is only about one-half the amount recorded for that year, namely, 17,642,677 pounds. But is it not rather significant that the smaller quantity was worth in market nearly three times as much as the larger, or $2,000,000 as compared with $663,043? To catch the smaller number, moreover, required some 400 more men, using I do not know how many more traps, and working I cannot say how much wider or more diverse a field.

Now it is such facts as these which lead us to pause when we hear of increased yields to this industry, and inquire if our friend has duly considered the variables in his problem. For until he has done this his assertions have no value, and may be grossly misleading both to himself and to others. So far as I have been able to analyze statistics at present available the conclusion seems inevitable that the lobster fisheries in both America and Europe have steadily declined from the time when they began to be pursued with the means and energy characteristic of modern conditions, beginning in Canada nearly a quarter of a century ago. The cause of this decline is evident; more lobsters have been destroyed than nature has been allowed to replace by her slow processes of reproduction and growth.

How have we tried to check this declining tendency by legislative and other means? Various curative measures have been adopted, which will be discussed more fully in another place, but for the present we can dwell upon the two most important only, the gauge laws, and the practice of artificially hatching the eggs and immediately liberating the young in the sea. The first is prohibitory, penalizing the destruction and sale of lobsters of either sex under 9 or 10½ inches in length, while the second is a constructive measure, by means of which it is hoped to increase the species.

I do not pretend to be able to award a just proportion of praise or blame for any measure or practice in such a matter, for I recognize that there are many doubtful factors in every biological problem, but I am forced to believe that both measures have been injurious to the interests of the entire fishery, the first by sanctioning the destruction of the best breeding stock, and the second by diverting large amounts of money and energy in an unproductive channel. The present gauge laws are a survival from the time when the biology of the lobster was not even approximately understood, and both measures seem to ignore or to neglect the law of survival, the importance of which can hardly be exaggerated. By the law of survival we mean the proportion of eggs or young which must survive and produce sexually mature animals in order to maintain the species at an equilibrium. It should be noted that while fishing has disturbed the equilibrium by reducing the number of adults, it has in no way affected the law of survival, which was presumably established at an earlier age, and which for all we now know to the contrary may persist until the race is extinct.

What is the rate of survival in the lobster? Since the sexes in this animal are approximately equal, and since to maintain the species it is necessary for each pair or for each mature female to produce only two adult individuals in the course of life, this rate would be expressed by the proportion $2:x$, in which x represents the average number of eggs laid by a mature female during the whole of her life. While this average number cannot be determined directly. inasmuch as female lobsters are destroyed at all ages, an indication of it should be given by determining the average number of eggs carried by lobsters of every age or size. By an examination of 96,098 egg-bearing lobsters from Newfoundland, Allen found the average number to be 23,000, which would correspond to a lobster 12 or 12½ inches long which had carried at least two broods, or 36,000 eggs in all. This would place the rate of survival at not less than 2 in

30,000, or 1 in 15,000. A much higher rate was indicated for the Woods Hole region, although my examination covered only 4645 individuals. Now when we consider that 8-inch lobsters when at breeding age produce on the average 5000 eggs, and that a 17-inch lobster, which must be at least twenty years old, has probably laid on an average nine batches of eggs to the number of 300,000, the average number sought is bound to be high. We may consider 20,000 or even 30,000, as a modest estimate, and well within the truth.

If the law of survival is a hard and stubborn fact, and if the average number of eggs approximates that given above, and I cannot see how such a conclusion can be avoided upon scientific grounds, their bearing upon the methods in question is evident. It means that this race of animals is maintained, not by paltry thousands, but by billions and hundred of billions of eggs. It means that the present and past gauge laws have been robbing this fishery of its best breeding stock, first because the breeding age is variable, and second because the number of eggs borne is proportional to the cube of the length of the mature animal. If the lobsters matured at a uniform age and size, and reached full breeding capacity at once, the question would be simplified, but neither of these conditions is fulfilled. The age of becoming mature covers a period corresponding to a length of a little over 7 inches to a length of a little over 12 inches, and probably not over 3 per cent of the 9-inch size, the legal gauge in certain states, have ever laid a single egg. Again owing to the rapid geometric increase in the product of eggs in relation to volume or size of the animal, the value of a 15-inch lobster to the fishery is vastly greater than that of the 9 or 10-inch size. Under the present gauge laws the fishery is being steadily depleted of the eggs which it sorely needs, which it must have if it is ever to be rejuvenated, and which it can get only through its larger and best breeding animals. Protection of the female lobsters with eggs already attached to the body is only a palliative since one-half of all mature females are without eggs at all times of the year, and since there is an overlap of a few weeks in summer when practically no females carry eggs attached. These conditions are brought about by the fact that the breeding periods are, as a rule, two years apart, and by the further fact that the bulk of the old eggs hatch before the bulk of the new ones are laid.

The hatching of the eggs followed by the immediate liberation of the fry is ineffective, because it cannot be done on a scale commensurate with the requirements of nature, or upon any scale which can be deemed profitable. This is seen to be the case by applying the law of survival to the records of the hatcheries during the period of their greatest activities. Thus for the decennium 1893 to 1902 the combined hatcheries of Newfoundland, Canada, and the United States turned out, according to the records 4,214,000,000 young lobsters. At a rate of survival of 1 in 15,000, this would yield 280,933 adults, many of which would certainly never enter a trap. At the lower rate of 1 in 10,000 the number of survivors would be less than half a million. In other words, during the ten years in question there were added to the ocean by this means some half million lobsters, while at the same time its waters were depleted of from half a billion to a billion adults. This suggests drawing from the spigot while our barrel leaks from the bung. Where then is it best to make the sacrifice, for some sacrifice must be made. Plainly, it would seem, among the younger breeding adults. Eat the young, and better lobsters in the culinary sense, and save the older, and better in a biological sense, for breeding purposes, as has been urged by Dr. Field, of the Massachusetts Fish and Game Commission. We do not say destroy all the young, for that would be quickly fatal, but fortunately all the lobsters of any given size do not enter the traps; but protect the young and adolescents at the one end, say up to the 9-inch length, and the older lobsters at the other end, say after the 12 or the 13-inch length has been reached. In a word, put the better breeders in a growing and protected class, the animals which produce eggs by the twenty, forty and eighty thousand at a time. Stop the wasteful process of hatching the eggs and turning the helpless larvæ into the sea, but rear them, if possible, to the bottom-seeking stage, and then distribute them with the greatest care, as the Commission for Inland Fisheries of Rhode Island has wisely done through the efforts of Dr. Mead and his associates. What the rate of survival may be in the lobster at the fourth or fifth stage, when it seeks the bottom of its own accord, with brand new powers and instincts fitted to cope successfully with its environment, is not known, but it is safe to assume that it is a hundredfold, perhaps a thousand fold, greater than in the helpless state in which it leaves its mother and seeks the dangerous surface of the open sea.

DISCUSSION

Mr. J. W. Titcomb, Lyndonville, Vt.: I was very much interested in that paper and am entirely in accord with it. I think it has been demonstrated that the lobster can be reared to the fourth stage in the latitude of Maine just as easily as in the latitude of Rhode Island. It struck me that in Maine, where the difficulties of rearing are almost insurmountable owing to cost, it might be feasible to rear a portion to the fourth stage and to confine the plant of this portion to a certain part of the coast and other plants to another part of the coast, and watch results. It might be some indication as to the comparative results of planting millions of fry and planting a much smaller number of fourth stage lobsters on another part of the coast. The Bureau of Fisheries has found out that it can rear lobsters in Maine and I hope the work will be continued.

Mr. C. W. Willard, Westerly, R. I.: The Rhode Island Fish Commission through its superintendent has sent a paper to this meeting that will touch upon the very points named in the paper just read, which I appreciated highly and enjoyed listening to very much. I did not intend to have the paper read this afternoon for the reason that it seemed to me that there was sufficient outside of this paper to take up the attention of the meeting. However, if there is sufficient time, I think perhaps the members would be interested to hear this very short paper written by our superintendent, Mr. Barnes. The secretary has the paper.

THE SEASON OF 1910 AT THE FISHERIES EXPERIMENT STATION AT WICKFORD, R. I.

By Earnest W. Barnes

It is not the intention of the present paper to give a detailed account of the season's work at the Wickford Hatchery, but rather to mention a few important results. In many ways the past season has been the most successful that the station has ever had. Particularly has this been true of the lobster rearing.

The hatching of the eggs began at Wickford on May 20th, and the season ended August 15th. Approximately 1500 ripe egg lobsters were received during this period and although many of these, especially in the latter part of the season, had considerably less than the average number of eggs, over half a million fry (511,274 by actual count) were reared to the fourth stage (the stage in which the lobsterlings begin to crawl upon the bottom). This number surpasses our best previous record by nearly 200,000 and is, furthermore, interesting in the fact that only 1500 egg lobsters were used while in 1908, the best previous year, over 3000 egg lobsters were required.

But these figures should not be taken as a basis for computing the best results obtainable per egg lobster by the methods used at Wickford, because we are often compelled, especially in the last and best part of the season, either to crowd our hatching cars or to permit lobsters of different ages to occupy the same car. This latter course is particularly disastrous because of the instinctive cannibalism, the older fry having a great advantage over the younger and consequently weaker ones.

In order to determine further possibilities of the method as at present developed, two egg lobsters, with about an average number of eggs each, were placed in a rearing car by themselves. On the next day when removed it was found that about half of the eggs had hatched from each. From this lot of fry, which equaled in number the eggs from one egg lobster, 7465 fourth-stage lobsters were produced.

The effectiveness of the apparatus was also determined in another way. Ten thousand one-day old fry were counted into a car and from this lot 6946 were reared to the fourth stage, a percentage of 69.4 per cent. The best previous result was 50 per cent from a lot of 1000. When it is borne in mind that in nature not more than 1 in 1000 of the fry hatched reach the fourth stage, these numbers assume greater proportions.

Furthermore great cheapness can be claimed for our method. The original cost of a plant of the same capacity as our present one would be under $2000. During the past year 511,000 fourth-stage lobsters were reared at a cost of a little less than $1000. This price includes food for the fry, labor, gasolene, oil, repairs and, in short, all the actual expenses of the plant, but does not include the cost of egg lobsters.

It is often asked how many of the lobsters we liberate reach marketable size. From the fact that when a lobster molts it sheds everything which could be marked it is impossible to answer this question accurately. But what is claimed for our method is that whereas in nature probably not more than one-tenth of one per cent reach the first "bottom" stage, under our method from forty to sixty-nine per cent have actually been reared.

We realize, however, that it is not enough to successfully rear the lobsters to the bottom stages. An equally important matter is to get them established in their future homes in the ocean bed. This problem we have been attacking from two different points, namely:

(1) The devising of more effective means than mere liberation.

(2) The effort to rear the fry to a still older stage and

in reality accustom them to living on the bottom of a car before liberating them. In this way we have reared 28,372 lobsters to the fifth, sixth, and later stages.

In regard to the devising of new and more effectual means of liberating it may be remarked that our usual method has been to scatter the lobsterlings widely along the edge of the shore, selecting for this purpose shores that were full of rocks and shells and as free from small fish as possible. This year we have tried out two devices for liberation in deeper water.

One of these is a covered box weighted with stones and with numerous large holes bored in the sides near the bottom. On the outside of the box strips of wood wider than the diameter of the holes are nailed over the holes in such a way as to leave a crack on the lower side of the strips large enough for the lobsters to get through and yet too narrow to allow fish to get in. As the strips are nailed on the outside only, the bored holes are left the entire size on the inside and can thus be readily found by the young lobsters in their endeavor to escape. The lobsters are then placed in the box, which is covered, sunk to the bottom and left for a day or two. In this length of time the lobsters will gradually have worked out of the box through the numerous holes.

The second and better method is to construct a wooden box with a tight cover and with the bottom made of galvanized screening eight meshes to the inch. This screen is fastened three inches up from the lower edges of the sides, thus allowing the sides to project three inches below the bottom of the car. Consequently the car may sink into the muddy bottom of the bay and still leave the screen bottom of the car a little higher than the mud. The mesh of the screen is spread in a number of places so as to leave holes large enough to permit the lobsters to crawl out. In lowering the car the inrush of water keeps the lobsters away from the holes and when the car rests on the bottom an enclosed place is formed under the screen between the projecting sides. Within this enclosure the lobsters after they have crawled out can burrow in the soil unmolested by fish. The car can usually be removed at the end of twenty-four hours.

The aim of the methods indicated above by which the Rhode Island Commission of Inland Fisheries is endeavoring to prevent the depletion of the lobster industry may be briefly summarized as follows:

The economical rearing of the lobster larvæ until they have acquired the habits and instincts of "bottom" life and then establish them upon a bottom suitable for their subsequent growth and protection.

In similar way the methods are being extended to include other marine forms.

In specially constructed cars it has been made possible this year for the first time to rear the winter flounder (*Pseudopleuronectes americanus*) in great numbers through the transition period when it leaves its upright mode of swimming, turns over on its side and becomes a flatfish. Several thousand were reared this spring in one car and it is the intention to rear flounders on a larger scale next year.

Late this summer a number of egg-bearing paddler or blue crabs (*Callinectes sapidus*) were allowed to hatch their eggs in a specially devised car, and while it is still too early to determine how many have successfully passed the larval stages it may be said that the eggs hatched well and up to the present time most of the fry seem to be living and healthy.

DISCUSSION

Dr. George W. Field, Boston, Mass.: I do not think either paper today has stated the great credit due the Bureau of Fisheries for the pioneer work in the development of the lobster hatchery, and the most admirable work carried out by the Rhode Island authorities. Too much emphasis cannot be laid upon the results of the work of these people. But it seems to me that something in addition should be done, as I have said at previous meetings and as I have always continuously said since 1902, namely, that there must be greater protection extended to the breeding adult in order to get a proper number of eggs.

Our suggestion is that a permanent close season be placed on lobsters above 12 inches long, in order to increase the number of young produced by nature. Then the Bureau and the state commissions will, in addition, preserve the eggs from the lobsters between 9 and 11 inches long, and thus increase in large measure the efficiency of the work as carried on at present.

To secure that and to secure an enforcement of the law which as it exists today is absolutely impossible to enforce without a deputy in every boat, we are suggesting that a law be passed making the lobster pot of a legal specification, that is, that the entrance ring shall be about $3\frac{1}{4}$ inches in diameter inside, with space between the slats of about 2 inches. That will permit the small lobsters under 6, 7 or 8 inches to escape; in any event, it will prevent the entrance of a lobster above 12 inches. Therefore by the inspection of the pots the inspection of the marketed lobsters will be rendered unnecessary. The law will then in a certain measure automatically enforce itself. The inspection of the pots will be as relatively easy then as the inspection of scales and measures. Each pot will be stamped by the inspector, and any pots which do not conform to specifications can be destroyed wherever found, whether in the water or elsewhere. It will be a severe tax on the fisherman to have his pots destroyed, as they are valued at 75 cents to $1.50 apiece; therefore the enforcement of the law will be relatively easy.

I believe that the situation in Massachusetts in any event demands some rather drastic measures. Our lobster supply has now come down to less than five per cent of the total catch. The relative number of egg lobsters in proportion to the number caught has dropped remarkably. Formerly one lobster in every 22 was an egg-bearing one. At present I have not the exact figures here, but it is not very far from one lobster in 150. That means a tremendous drain upon the productive capacity of the race, and we have simply done it by killing the lobster at the wrong end, that is to say, by killing the breeding adults.

THE EFFECTS OF EXPOSURE ON THE GILL FILAMENTS OF FISHES

By Raymond C. Osburn

What I have to present this afternoon will be rather in the way of a preliminary study of this question, since I have not been able to carry it to fulfilment in every respect.

I presume that many of the fish culturists present have noted that in rearing trout and salmon numbers of the fry show one or more aborted gill covers, thus exposing the gill filaments on one or both sides. I do not know how general this is, but I have spoken with several fish culturists, engaged both in Government and private work, and know that this condition is frequently presented by these fishes.

Sometime ago I examined a tank of 486 yearling silver salmon in the New York Aquarium and noted a large number with the abnormal gill covers. With the right opercle abnormal there were 44, with the left opercle abnormal 27, with both gill covers abnormal 18. This makes a total of 89 abnormal out of the 486, or 18.31 per cent.

I began this investigation with the intention of trying to discover whether those fishes which had abnormal gill covers were more readily eliminated than those which were normal, but the care of our aquarist has been so good that only a few fishes have died since my observations began a couple of months ago, and I am not able to draw any conclusions in regard to that point. I do want to show you, however, what happens to the gills, and, perhaps, I can do that best by a few rather crude charts which I have drawn up hurriedly and under the strain of business. (Charts exhibited.)

This chart illustrates one of the gill covers sectioned for microscopic study, and shows how it is turned under. The normal gill cover extends straight out over the gill chamber. The extent of the abnormality varies greatly; in some cases only the tip of the opercular element of the gill cover is turned in, while in other cases it is turned in clear to the preopercular bone. The latter is the usual condition and a large area of the gill filaments is thus exposed. I have in this jar such a specimen. Only one side is affected, and you can readily see from this how much of the gill is exposed.

We might naturally expect that the exposure of the gill directly to the exterior would have some effect on it. We know very well that when epidermal tissue is exposed to friction it tends to become thickened, and that is the condition here.

I have here a diagram of a normal gill filament, with the smaller lamellæ on either side, showing the general proportions of the blood-vessels in comparison with the very thin layer of epidermis which covers them. This layer is composed of only a single series of very much flattened cells, so that the blood in the capillaries comes very near to the surface.

Now, comparing with this normal filament an abnormal one, we find that while the axis and the general arrangement of the main blood-vessels are the same, at the tip there is often a portion which is very greatly modified. Sometimes as much as half of the gill filament is without the secondary lamellæ, and frequently it is abnormally enlarged at the end. Often a number of the lamellæ are fused into one mass, or partially fused at the base, or, again, they may be greatly abbreviated. Wherever the filaments are exposed to any extent we find them knobbed at the end, and the external layer of cells is very greatly modified. The cells, instead of being much flattened, become cuboid or columnar, and, especially at the ends where they are more exposed, we often find two or even three layers of these cells separating the water from the blood.

Naturally a gill filament so modified cannot be as effective in absorbing oxygen from the water and giving off carbon dioxide to it as one that has a thin, unmodified layer.

There is here a rather curious biological paradox. The thickening of the gill filament is, of course, for the purpose of protection. If it is exposed, its very thin, delicate nature renders it liable to injury. The thickening of the gill is a remedial process to relieve that danger, but that very process at the same time must necessarily interfere with the purpose of the gill filament in absorbing oxygen. In other words, this process of nature which preserves the gill filament as a whole at the same time renders it less effective as a means of absorbing oxygen.

I have not been able, as yet, to find out just what effect these thickened filaments have on the fishes. It may be that some compensatory hypertrophy of the gill lamellæ occurs in protected regions of the gill to render such fishes as efficient as normal ones in oxygen absorption. But there is no doubt that if the fishes were in their natural environment, such exposed gills would render them much more liable to the attack of parasites in the gill region, and perhaps to the attack of some other enemies as well.

I hope to be able to carry this investigation further, and, if possible, to learn what produces this abnormal condition. I suspect that crowding of the young fry may be responsible for it, because in the small hatchery of the Aquarium the fry often do not have sufficient space. The condition is observable very early—in fact, almost as soon as the fishes are hatched out and begin to lie crowded together in our hatching tanks. I know that the same thing also occurs in some of the commercial hatcheries, and that there is a great amount of variation in the percentage of abnormality in various hatcheries.

I have never observed a single fish developed under natural environment,—and I think I have seined millions of them myself—with this condition. Perhaps some of you may have observed them in your work on wild fishes. I would be very glad to have any suggestions or information that you may have to give on the subject. I hope, as I have said, to be able to discover the reason for this; and if we know the reason it may then be possible to eliminate these abnormal fishes from the product of our hatcheries.

DISCUSSION

Mr. John W. Titcomb, Lyndonville, Vt.: I would like to ask if the speaker thought about the lack of oxygen in the water as a cause of the trouble. Perhaps the overcrowding theory would be the same in its results, but in the commercial hatcheries in a great many instances the water supply is right out of the ground. Now at some of these hatcheries the percentage of short gill covers is very much larger than you mentioned, perhaps 10 per cent.

Dr. Osburn: In the lot I measured it was 18 per cent.

Mr. Titcomb: I should think it would be as large as that in some of the hatcheries. But the hatcheries are supplied with water by springs or artesian wells 30 feet or more below the surface of the ground that is led directly into the pond; and I always had the theory that the water did not contain sufficient oxygen. The fish that you raise in those waters under domestication—the succeeding generations from the fish you have there—seem to do better than the fish from the eggs of wild trout in some instances. In other words, they become wonted to those conditions.

Dr. Osburn: The water in the aquarium is well aerated and is the same supply as given to adult fishes. A large quantity of water is sent through the hatching tanks, sufficient to carry the fish to the lower end of the tanks, and I do not think that there is a lack of oxygen; but it might be that lying closely together at the lower ends of the tanks where they are likely to congregate, the fish are in some way over-crowded. Perhaps the thin gill cover of the very young fish might get inverted or pushed in, started wrong, and all successive growth will only make it worse.

A point I failed to mention in speaking of the condition is that these thickened gill filaments show white instead of red. Where the gill filaments are exposed in the normal fish, they are bright red as you know, but where these exposed filaments are seen they at once show absence of blood supply or its remoteness from the surface by their whitish color. They have not the scarlet areas that normal gill filaments should have.

Mr. M. C. Marsh, Washington, D. C.: I have seen some case—I cannot remember just where it was—but I think it was in an aquarium of brook trout—where almost every fish had the short gill cover and the gill filaments exposed. Now the gill cover was not folded, as Professor Osburn described, but was merely very short, and I think, as I remember, that almost every individual fish had it. I have examined a great many wild trout but have never seen it in any such fish. It seems to be a disease of captivity and domestication, like so many more which you can refer to no more specific cause than domestication and captivity. This summer I recall four or five adult trout that were transported from a state hatchery to the place where I was working.

They were of good size, and everyone had quite short gill covers and in everyone the uncovered filaments were badly infected with this common parasite that attacks the gills of brook trout.

Were these all brook trout?

Dr. Osburn: No, they were silver salmon; but our brook trout are affected the same way and so are some others of our salmonoids.

Mr. Marsh: And was it always a turning over of the opercle?

Dr. Osburn: I have not examined in all cases, but all that I have observed are rolled in. They are so flattened against the outside layer that if you do not section them you may overlook their being rolled in.

Mr. Marsh: That may be. Some may have been folded over. I recall a wild humpback salmon that I caught in Alaska which had its gill cover not turned under but outward. That had been done apparently a long time before; and the inner surface had become an outer surface and had all the characters of the outer skin. But that has nothing particular to do with this matter.

Dr. Osburn: The gill filaments were exposed in the same way?

Mr. Marsh: Yes.

Mr. H. F. Hurlbut, East Freetown, Mass.: We have pretty much eliminated the gill-cover disease from our trout, and I think it is because we put our fry into the pond as soon as we teach them to eat. We remove them quite early and have very little trouble now. We are careful not to take any eggs from the short-covered trout. We have had this trouble when keeping our trout in the troughs, which may be one cause.

Dr. Osburn: I thought of testing that out and putting some in troughs where they will be very much scattered, and then putting in another bunch very much crowded, to see if the proportions are larger. I think that might answer the question perhaps, as to whether the crowding alone is the cause of it. I thought perhaps the reason why we have not found any wild fish so affected was that they would be more readily eliminated in nature. The attacks of enemies might rid the waters of them before we were able to get hold of any of them. I have not had great experience in collecting salmonoid fishes wild, but in all the various other kinds of fishes I have collected, and I have spent many years seining, I have never seen wild fish with short gill covers.

Mr. F. N. Clark, Northville, Mich.: I hate to upset the theories of these gentlemen but I must. (Laughter.) We at Northville feed brook trout to the fingerling stage and keep them in the tanks longer than anybody else, as Mr. Bower knows. Now with these, up to the fingerling stage, 2½ inches, we do not find any short gill covers; but after they go out in the pond they get the disease.

President: That seems to reverse Mr. Hurlbut.

Mr. Dwight Lydell, Comstock Park, Mich.: About a week before I left to attend this Society meeting, we were seining some minnows out of a creek and captured three rainbow trout 5½ or 6 inches long. I noticed one of them had a short gill covering on one side. They were trout planted there from one of our hatcheries. Whether they would be considered wild trout or not I cannot say. I think the short-gilled fish is now in the aquarium if it has not died or been thrown out since I left there.

DR. OSBURN: I do not know what the experience of the hatchery men is in regard to that, but the conditions are observed here when the fish are very small, before they become active enough to look for their own food. Of course, the condition in that case would not be such as Mr. Clark describes, that is, of the disease coming on after they were planted. It may be a more complicated problem than we think. There may be more than one thing that causes the trouble.

MR. TITCOMB: There is one place in Vermont where you can inspect 7,000 or 8,000 trout this fall, and can continue for about a month. They will all be handled by one of the fish culturists of the Bureau of Fisheries. If you correspond with Mr. Carter, the superintendent, he can have his men see if there are any short gill covers on those fishes. I think I have seen a few there, but it might have happened in the hatcheries before they were put out.

DR. OSBURN: The only criterion would be to get hold of those which were in wild streams that never had been stocked at all, if it were possible.

MR. TITCOMB: Almost all the fish in that pond were hatched artificially. They have been handled for ten years, to the number of 8,000 to 10,000 every year. They go up one stream, and are stripped there; and now we must have fish that are almost entirely artificially hatched, and released partly as fry and partly as fingerlings. But very few have the short gill cover.

MR. R. E. FOLLETT, Pittsfield, Mass.: Is this due to malformation from overcrowding, to the nibbling of the fish by each other—nibbling fins and gills, or to the presence of bacteria?

DR. OSBURN: I have not seen any evidence in the gills that would seem to indicate it was due to parasitism at all. I have not gone back far enough in the history of the young to note whether it is produced by nibbling. It would hardly seem probable, because we know that the opercles, gills, etc., can be regenerated normally and do so under experimentation. It may be by nibbling the tip of the opercle it gets turned under and does not get pulled out in the proper place again and remains that way. I do not know how the thing starts.

MR. FOLLETT: I have seen trout two or three years old with short gill cover; and I have caught them two or three years afterward and the gills were still exposed, although they were in a healthier condition than when liberated.

DR. OSBURN: They certainly live well here in the aquarium.

THYROID TUMOR IN SALMONOIDS

By M. C. Marsh

Tumors of many kinds or types are known among fishes, most of them rare and of little interest to the fish culturist, though of importance to the comparative pathologist. Among the members of the salmon family the so-called throat or gill tumor, which is the thyroid tumor, is common in domestication, and of particular interest from several points of view. Somewhat as the general class of tumors includes the cancer, so this thyroid enlargement in fishes has a stage which the cancer pathologists have diagnosed as cancer. Since cancer is the most terrible of the unsolved scourges of the race, and the most baffling of the riddles of pathology, its occurrence in any of the lower animals provides a valuable field for comparative study and experiment. The mere fact that this disease or its underlying stage is common among domesticated fish is sufficient to challenge the attention of all interested in fishes or fish culture.

A tumor in its literal or broadest and earliest signification means a swelling of any part or tissue of the living organism. As used in pathology it includes those numerous kinds of enlargements which are true new growths or abnormal and more or less unlimited increases of pre-existing normal tissues. Technically tumors include the malignant growths, as carcinoma or cancer and sarcoma, as well as the benign. All are classed together under the one general head because of the quality common to all, of abnormal growth, unchecked by the ordinary physiological limitations.

The thyroid tumor in fishes is an enlargement of the thyroid gland. This is a small ductless gland with an internal secretion essential to the health of the animal. In the fish it is located beneath the floor of the mouth, or under the junction of the pair of second gill arches. Through this region beneath the floor of the mouth on the median line passes the ventral aorta, giving off branches to the gills. The particles making up the gland are distributed immediately about this vessel, and are scattered to some extent about the adjacent region, even out along the gill arches on either side. The thyroid is not recognizable to the naked eye as a distinct and definite gland or organ because of its small size and the separation of its units and their distribution among other tissues. By an ordinary dissection of the fish the gland would scarcely be discovered. Even in microscopic sections it is an obscure and easily overlooked tissue. Yet under an unknown stimulus it may grow until it appears externally and becomes larger than any other organ of the body.

The first external indication of thyroid enlargement is a red streak or spot on the floor of the mouth at or near the second pair of arches, the so-called "red floor." It usually, probably always, precedes any externally visible enlargement when the thyroid is growing upward. This reddening area on the floor of the mouth indicates the increasing blood supply accompanying the increase of thyroid tissue. The direction of the thyroid growth may be entirely downward, doubtless without the tell-tale symptom of the red floor. The continuance of growth may be in almost any direction. The lines of least resistance are sidewise and downward, and here the tumor is most often brought externally visible, though it frequently penetrates the floor of the mouth, which is chiefly cartilaginous, and occupies space directly within the mouth cavity. As it swells outward it carries with it the thin skin, or epithelial covering about the throat, and this skin becomes the covering of the tumor. In advanced cases the tumor infiltrates or grows into the skin as well as extending it by pressure. The small terminal gill filaments of the foremost gill arches extend out upon this epithelium, and are often seen stretched by large tumors till they can carry no blood. Almost every tumor, while it may incline to one side or the other, originates on the median line. The body of large tumors may have grown wholly toward the left or right side, but will be found to spring from the middle region. In rare cases no part of a tumor is in contact with the median line but arises from an isolated particle of thyroid out on one of the gill arches.

The tumors swell out into the mouth and throat, regions well covered and protected and but little visible to a casual observer without the fish in hand. Tumors are sometimes visible when the fish is in the water, but usually this is not the case. To find them the fish must be taken up, the mouth opened and the cavity examined, the gills then widely spread and the throat examined from below. Tumors of considerable size are often present but unsuspected from the appearance of the fish with the mouth nearly closed and the gills folded. It is in fact surprising what a considerable percentage of visible tumors may exist in a brood of trout without the knowledge of the fish culturist in charge of them.

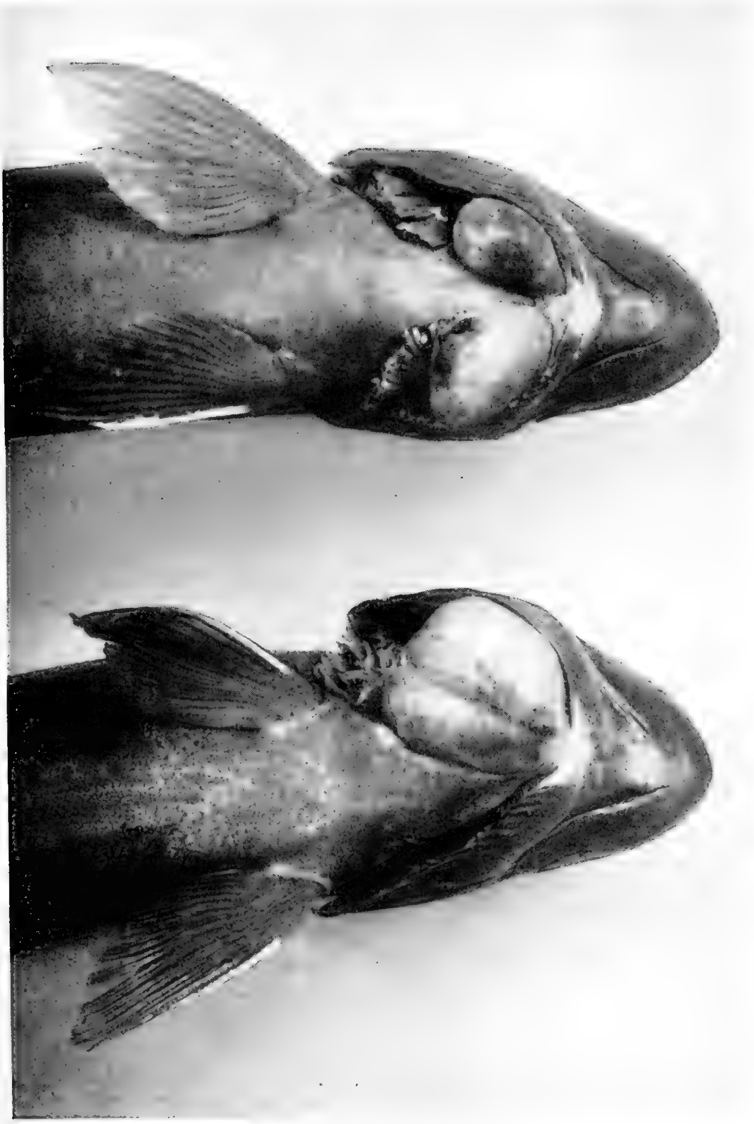
Not all tumors, however, originate within the thyroid region proper, that is, internally. Besides the few occurring on the gill arches, the tip of the lower jaw is an occasional location. The most common external source is the gular pit, a depression formed of infolding of the skin on the median line of the throat. A tumor in this location may be a direct outgrowth from the thyroid region, but it seems certain that many cases originate entirely from the integument at this point and are quite independent of the main deposit of thyroid. In this case they may be classed with those enlargements occurring on the tip of the lower jaw. Whether or not these grow from isolated thyroid deposits has not been demonstrated.

Most tumors of some size are rather soft and yielding in consistency, and of a reddish hue from the abundance of blood contained. Frequently they are cystic and become abraded and bleeding from scraping against hard surfaces.

In size they sometimes become relatively enormous, approximating the size of the head of the fish. They may greatly distend the gills and almost fill the mouth, interfering with breathing and eating. These cases are extreme and relatively rare. All gradations in size and form down to the barely visible external enlargement and the red floor are seen.

Microscopically the thyroid tumor has the appearance of a modified thyroid gland. It is not as if the gland had merely grown immensely larger and nothing more. The units which compose the normal thyroid are enlarged and variously changed in shape and in the size and shape of their individual component cells. The colloid substance which fills the spaces of the normal thyroid follicles has decreased or disappeared. The microscopical picture is varied, depending on the age of the growth of the portion of the tumor under examination and on unknown factors. This subject is purely technical and needs but brief discussion here. It may be said that the thyroid tends, in its abnormal, lawless growth not merely to press outward and push away surrounding parts, like a ball growing larger, but to penetrate and invade and to some extent destroy any tissue standing in its way, whether muscle, cartilage or bone. This invasion or infiltration of surrounding tissues is a characteristic mark of cancer.

The thyroid tumor occurs especially among the salmon family in fresh water. It is best known in the brook trout, or char, and is also common among the rainbow and brown trout, various hybrids of the char, land-locked salmon and in hybrids of the Pacific salmon but not in any sea-run pure salmon species. Scotch Sea trout are practically immune. So far no case in marine fish has been reported. It will have impressed the fish culturists who have noticed the distribution of these tumors that they occur in the salmon family when its members are domesticated in fresh water. These facts appear significant. Whatever they mean they lose something of their apparent importance



THYROID TUMORS

Adult female rainbow trout with advanced tumors. Three-fourths natural size

when it is seen that the disease is not exclusively among trout and salmon nor only among the subjects of fish culture. An adult whitefish was taken during the past winter from Lake Keuka, N. Y., with a well developed thyroid tumor. There has recently come to light a museum specimen of an adult brook trout caught in 1902 in Hosmer's Creek, a stocked stream in western New York, having a large thyroid tumor. This was to all intents and purposes a wild trout, though it may have been derived from a domesticated fish. The whitefish, however, are not artificially fed in hatcheries and are held scarcely beyond the hatching period. The causative factors of the disease which are intensified in the artificial fish ponds are present also among the natural conditions surrounding wild fish. The prevalence of the disease among salmonoids has doubtless to do with the great extent to which these fish are cultivated as well as with a natural susceptibility to thyroid enlargement.

The disease runs usually a slow chronic course, with occasional acute outbreaks of more rapid progress and higher death rate. Ordinarily only a low mortality accompanies it but it is difficult to say just what this is, since secondary causes are probably the immediate cause of death of many tumor fish. There is no definite picture of symptoms and effects of tumor growth upon the fish. The mere mechanical effect of the growth by interfering with breathing and eating is certainly considerable but does not explain all the cases of marked anemia and poor condition, reaching sometimes to extreme emaciation. The material of which the tumor is composed contains some substance, probably identical or similar to the extract of the thyroid gland, which is highly toxic to the fish when injected into the circulation. When the tumor is ground up, mixed with one to three volumes of physiological salt solution, and about 1/10 c.c. of this injected directly into the thyroid region many of the fish are killed, in some cases nearly everyone injected. This fact interferes greatly with efforts to transplant the tumor from fish to fish. Both the fluid extract and the undiluted particles of tumor are alike fatal. Thus every fish bearing even a small visible tumor is carrying on its own body many times a fatal dose of poison, which is harmless only because it is withheld from the circulation.

The beginning of enlargement occurs in the hatchery during the first few months of the existence of the fish and practically all individuals are affected. The external appearance is perfectly normal. The visible tumor stage is usually not reached until the fish become yearlings. One brook trout of five months, however, was found dead with an advanced type of thyroid disease. Among the yearlings the tumor is seen upon handling and examination, and they may have tumors of relatively large size. In the older fish the enlargement reaches its greatest development. The percentage of fish bearing visible tumors varies greatly. Four per cent has been observed among brook trout yearlings, and 30 per cent among older ones and these are probably not extraordinary cases for this species. In acute outbreaks nearly every fish may show tumors. Hybrids of certain of the Pacific salmon, as the blueback and humpback, in process of rearing seem to be especially susceptible and the disease runs through them like an epidemic. In one case 16 per cent of visible tumors in April increased to 92 per cent by the following August, with an accompanying heavy mortality. Humpback salmon yearlings in fresh water at a hatchery showed the same involvement and rapid course. If we add to those showing visible tumors the number showing the red floor only we get a substantial increase, the total indicating the number showing some visible evidence of thyroid enlargement. Brook trout adults frequently have half the fish or more in this category.

The effect of the tumor is obviously in part mechanical. It is difficult to separate the effect of mechanical interference with respiration and feeding from the systemic or constitutional effect of an internal secretion capable of bringing about the same anemia and inanition that follows such interference. There is certainly an anemia, sometimes very marked, in fish with the tumors but it is not an invariable accompaniment. Moreover, this anemic condition is not well correlated with the size of tumor and amount of mechanical interference, the extreme anemias sometimes occurring with the smallest tumors and the high blood readings with large tumors. Of ten two-year old brook trout with tumors of various sizes the hemoglobin readings averaged 16.9, with 29 for the highest and below 10 for the lowest, the limit for the instrument used. The average of 8 healthy, clean fish of the same lot was 37, with none under 30. This very clearly and definitely shows a paler blood accompanying the tumors and it is not improbable that the tumor has a physiological effect in many instances.

The thyroid gland being normally almost microscopic, and in its enlargement reaching beyond the size of a walnut, must proliferate enormously. In doing so its structure passes through a wide range of changes and presents very diverse pictures, not only in different tumors but in different parts of the same tumor at one time. These pictures are typically those of goiter and cancer. We have to do with a process which is anatomically continuous, that is, the tumor or enlargement is an anatomical entity from its earliest increase to the largest growth or most advanced stages, whatever phases it passes through. This is less true of the nature of the pathological process. At the beginning it is a fish goiter, or is analogous to goiter in man. At the end it is fish cancer or is analogous to thyroid cancer in man. In both man and fish thyroid cancer begins as a goitrous enlargement, and there is the same difficulty of a dividing line in both. We have to do with a border line process which is pathologically various, which naturally leads to and includes cancer, without a sharp line of demarcation. Every tumor cannot be placed definitely in its entirety in one or the other category. The diagnosis of incipient goiter in fish is simple, while that of thyroid cancer in fish is complicated by a lack of absolute standards. The question is how much of the thyroid enlargement is cancer or where is the dividing line, rather than whether or not the process is cancer. Cancer is preëminently a subject for the medical specialists and it is to these we must look for the diagnosis of the nature of the lesion. That this thyroid tumor in fishes includes in its various stages of development both goiter and cancer is the practically unanimous verdict of the cancer authorities and is denied by none. Every visible tumor in the thyroid region is not necessarily a cancer, however. From the standpoint of fish culture we need not attempt a separation of our affected fish into the goitrous and cancerous, but we must recognize in practically all domesticated salmonoids an underlying goitrous condition out of which cancer may at any time develop. Just when and where this cancerous stage begins is beyond any sharp definition, but when fully established it is as well recognized microscopically as the earlier goiter. If one considers the large number of fish with enlarged thyroids it is doubtless true that cancer is comparatively rare among them, for most of them are in the early stage of goiter. The enlargement is arrested in most individuals and does not even become visible externally. In many it remains small or scarcely visible. In the few others it proceeds to relatively enormous size with usually the development in various degrees of the cancerous character as evidenced by its structure and tendency to infiltrate or invade other tissues. It is, of course, true that the appearance under the microscope, while the chief historical criterion of cancer, is not the only or controlling one. Transplantability into other individuals and the occurrence of metastases or deposits carried from the original growth to distant organs through the circulatory systems have been held to be inherent properties of the cancer process, and where they occur all doubt of the cancerous process is removed. These characters are not always exhibited, however, but to prove their absence would require a mass of negative results from prolonged experiments which if obtained at all will not be presented for years to come. They have not yet been definitely shown to apply to the thyroid tumors in fishes and perhaps there is ground here for raising a question whether cancer has been demonstrated in the thyroid tumor. Moreover, nobody can foretell what trend of cancer investigation will in the end solve the problem, and it is not impossible that the future may put the fish thyroid tumor outside the true cancer as finally defined. Meantime we may insist that there is only a presumption, though an overwhelming one, in favor of the view that this tumor includes cancer. This presumption is created by the broad facts in the case. Cancer is found everywhere throughout the vertebrate kingdom, among the cold-blooded as well as the warm-blooded animals. There is a sort of specificity of certain kinds of cancer for certain of the lower animals, as epithelioma of the eye in cattle, cancer of the breast in mice, sarcoma in rats, and round-celled sarcoma of the genitals of dogs. These special occurrences of cancer in animals are doubtless related to the species and its habits and mode of life. Thyroid cancer in fishes, water animals with a specialized and restricted mode of life, fits naturally into this series. While cancer of other regions than the thyroid undoubtedly occurs in fishes, the thyroid tumor is the most striking of the neoplastic growths among fishes, and has a striking resemblance to cancer. It does not so much matter that this cancer is a terminal stage, the occasional climax of a milder and commoner process. What is important is that we have in fishes a process exactly analogous even in the beginning to a serious human disease, and that this process is linked with and leads on to another which is in the same way analogous to a more dreaded disease of man derived from unknown sources.

The cause of thyroid tumor is unknown, as is the cause of all tumors. One factor that is known in some cases of malignant growth to play some part in causation is mechanical injury or irritation. Applying this to fishes we can find no injury preceding thyroid enlargement. Derangement of metabolism, or the life processes of the fish, due to the changes which domestication and occasional conditions in the life of wild fishes produces, is one of the possibilities. One can imagine that too great a burden is thrown upon the small thyroid gland and that it enlarges in response to a demand. The parasitic theory of the origin of tumors is entirely unproved but when it is applied to the thyroid disease of fishes as an explanation it fits rather better than any other. One may cite the increase of disease in the lower of successive ponds draining in series, one into another; the spontaneous recovery under substantially the same conditions which cause the growth, the immunity of some species, and different broods or strains in the same species; its occurrence among wild fish; the effect of such drugs as iodine and mercury, possibly acting antiseptically. Thyroid tumor is chiefly a disease of domestication like so many other diseases of fishes. But domestication cannot be said to be the cause, though its conditions evidently favor the development of the disease. The tumor develops also among wild fish, as has been shown, and though rarely, yet the specimens known show typical tumors of good size. The essential cause of the disease occurs without as it does within domestication but by the latter it is intensified, increased in amount or virulence, raised in power, changed from a latent to an active state, or in some way made to develop tumors. As the crowding of fish—not necessarily overcrowding—lessened water supply and artificial feeding are the most distinctive features of domestication, these may be inferred to be the secondary factors related to causation—one or more of them. What this relation is it is quite impossible to say at present.

As with cancer and goiter in man, there are at present no known remedies or measures which will definitely either prevent the inception of the process or cure its developed stages. To increase the water supply, reduce the number of fish dealt with and feed more natural foods are practices obviously having a tendency to combat the disease, since these things are the essentials of domestication with which the tumor especially associates itself. To practice these measures would be an abatement of domestication and in a sense and to a degree would amount to killing the patient, since it is the disease as affecting domestication that is important rather than individual fishes. This may possibly be necessary in the end, but what is needed is something consistent with intensive breeding. Domestication simply must increase the ratio of fish to water over the conditions obtaining in nature, and thus far an inexpensive natural food has not made its way on a large scale in fish culture.

Thyroid gland is known to have a specific affinity for iodine and the observations of Marine and Lenhart in conjunction with the Pennsylvania Department of Fisheries have shown that the thyroid in its early or microscopic enlargement reacts with iodine in the direction of a reversion toward the normal structure. We have corroborated this during the past summer and have also exposed visible tumors to the action of potassium iodide for thirty days. With these the results are not uniform, some showing considerable decrease in size, others remaining unchanged. This is in accordance with the view of a process in which both goiter and cancer is concerned, the tumor tending to lose its response with the increase of its cancerous character.

We have also found during the past summer that the same results in the way of reversion of structure and reduction of the visible tumor are obtained with mercury as with iodine and somewhat more rapidly. Mercury is not known to react specifically with thyroid and therefore it is at least questionable whether the action of iodine on the enlargement is due to its specific relation to thyroid tissue. It is as reasonable to assume an antiseptic action, not in the water, for the changes occur at great dilution, one part to five million parts of water, but cumulatively in the enlarged gland itself. In fact, the rapid reduction of the tumors by these elements, for one of which the thyroid is known to have a special affinity, and both of which are cumulative agents much used against infectious disease, is quite consistent with the theory of infection as the cause of the enlargement. In the light of this, the fact that iodine affects the thyroid tumor can hardly be an important argument against its cancerous nature. Many agents, including chemicals, affect cancer cells and inhibit cancer growth, particularly in early stages.

Since iodine, mercury, and almost without doubt various other chemicals, cause a reversion of structure and a diminution in size of the tumor, some of them are possibly a preventive, when properly administered, of the initial enlargement and thus of the whole process of tumor growth, but the demonstration of this is yet to be made. Iodine in the form of potassium iodide can be readily added to the water but on a large scale would prove expensive. To incorporate it with the food would be more economical and a method of conveniently administering it without loss could probably be found. Mercury is far more toxic than iodine. Perhaps a more suitable substance than either may be found.

The thyroid tumor, either in its goitrous or cancerous stage, as an enemy to fish culture is hardly a matter of the first importance. The percentage of affected fish is usually low, rarely does it take on the acute form of an epidemic, growth can proceed even with the increase of the tumor, and the fish breed without apparent hindrance. But it is a rather sinister suggestion that fishes so much the subject of artificial propagation and distribution as the chars and trouts have either goiter or cancer, especially the latter. Goiter in man is known as a dangerous often water-borne disease and a certain per cent of cases develop into cancer, although goiter is a disease of youth and cancer of maturity. It does not add to the attractiveness of fish culture for the public waters that these much sought and widely distributed fish are subject to goiter. But when cancer is added there is a sentimental if not a real reason for alarm. The cause of cancer in any animal is unknown and therefore a fruitful field is offered for conjecture and disquieting inferences which are as impossible to disprove as to prove.

What is the case that might lie against the salmonoids in the matter of cancer, and how definite is the evidence in support of it? It is that in some way, certainly indirect, obscure and probably occasional or rare, fishes are a factor in the cause of human cancer and aid in the spread or transmission of this disease. Among the many theories of cancer causation is that which ascribes the cancer process to a living organism—a parasite. If this theory is finally substantiated it will afford a case of parasitism radically unlike all known forms of parasitic disease. It is only on the assumption of such a parasitic factor in cancer that any causal relation between fish and human cancer can be maintained. Now there are two general facts which appear rather vaguely to bear an important significance. Attention has been frequently called in the medical profession to a seeming relation of cancer to water. There is a considerable literature citing statistics showing a concentration of cancer along water courses. It is evidently a fact that the well-watered regions of the United States are favorite cancer localities, rather than the drier or arid regions. It is, of course, in these watered regions that fish thrive and are artificially propagated and planted. It has been said that a map showing the distribution of the chars and trouts in this country would by the same tokens illustrate the distribution of cancer. This coincidence may be accidental but the fact is interesting and suggestive. The other general consideration is that the probable increase of cancer during the last few decades has been simultaneous with the development to large proportions of the artificial propagation of the salmonoids.

Now, no one suggests and it is not credible that any case of cancer has been or will be caused by eating fish of any kind. Cooked fish will transmit no disease and in this country no one eats them raw, and even in that case no transmission of cancer need necessarily be inferred. The most that can be said is that we have a mere circumstantial suspicion against the chars and trouts, members of a family with an excellent reputation. The case should be investigated for several reasons, the least of which is that there is any possibility that propagation increases the prevalence of cancer. Other reasons are sufficient to lend importance to thyroid disease in fishes. One controlling consideration is that the chief source of knowledge of human cancer lies now in the study of analogous processes in the lower animals. Rats and mice and other mammals have been largely used for this purpose. Fishes now open a fruitful field for investigation on account of the complex nature of the medium in which they live and its intimate relation to human life and activity. That they seem likely to supplement the warm-blooded animals and furnish subjects in which by experiment the obscure cancer process may be seen in a new light, is a cause of congratulation to the medical profession and a source of some consolation to the fish culturist. The experimenters will look to fish culture for the necessary material in the form of tumor bearing fishes. But fish culture has a further interest in that it is responsible for breeding these fish and should protect itself against even the suspicion of any evil effect resulting. It is desirable that the whole subject be investigated and it is appropriate that the Government as one of the most active agents of propagation should undertake the task. In this the province of the federal and state organizations for fish culture, and the federal agencies of public health seem to overlap. The pollution of public waters, a menace requiring to be dealt with from both standpoints, may be the keynote to the situation. It is pertinent to cite again the rarity of thyroid disease in wild fish, its frequency among domesticated, and to consider that the few cases known among wild fish are from waters close to civilization. Cancer is a disease of civilization. It is rare among the American Indians, common among the whites.

The question of applying the term cancer to the thyroid disease in fishes is a matter of terminology which resolves itself ultimately into the question what is cancer. Cancer is an ugly term not necessary to accuracy as applied to fish thyroid enlargement, and may come to have an unduly alarming implication in the public mind which will not always suspend judgment or weigh evidence judiciously. Infiltrating goiter, or still better, merely thyroid tumor are better and sufficient designations in non-technical discussion of this interesting disease of the salmonoids.

It is timely to remember that in any consideration of cause and effect as between fishes and cancer in man, it is exactly as reasonable that the trout have acquired the disease from the human race as that the transmission has been in the reverse direction. If transmissible in one direction it probably is in the other and in that case fishes might become important as a medium, or reservoir of disease. But these are hardly more than speculations to which the more reasonable alternative is the assumption of a common cause for cancer in man and fishes.

DISCUSSION

Dr. B. M. Briggs, Brooklyn: Has chromium been tried? It has been found useful in many cases. Have you tried arsenic? That makes the mercury and iodine much more effective.

Mr. Marsh: It has been thought to try arsenic and chromium and as many elements as have an antiseptic action as soon as we have time.

Dr. Briggs: Have you noticed in waters where iodine is present that the disease is found more frequently than where the iodine is absent?

Mr. Marsh: The sea water has iodine, and this enlargement has not been reported, as far as I know, in any strictly salt-water fish. The fresh water has no iodine, as far as I know, except in infinitesimal dilution. We had examination made of the water of a natural brook used at a hatchery where tumors occurred, but we could find only one part of iodine to a billion parts of water. I suppose that is negligible and has no effect on the fishes. As for fresh water containing considerable amounts of iodine, they usually occur in mineral springs. I do not know of any fresh water where fish live containing much iodine.

Mr. John W. Titcomb, Lyndonville, Vt.: The last inquirer was leading to the same question I was going to ask. I wanted to ascertain if you examined the waters where the disease was most prevalent to see whether they contained any unusual chemical, or whether the disease was more prevalent in hard water than soft water, for instance. One of my own family got a thyroid tumor from drinking water from a spring in West Virginia, and the same summer the water of another spring gave a thyroid tumor to a lady, wife of one of the judges in the district. I am not a medical man but I want to know if you have gone into the qualities of the water. This water I have referred to did in both instances contain trout.

Mr. Marsh: We have analyses of a large number of fish-cultural waters. The disease is widespread among nearly all these waters. They are mostly spring waters and we have nothing to compare them with. We have gone into the subject and can find nothing that you can correlate with the development of tumors. There is no chemical evidence so far with respect to the dissolved substances in the water which shows anything whatever as far as I know.

Dr. W. P. Herrick, New York City: On the point of thyroid tumor and its connection with water, in the human race it is well known that thyroid enlargement is most prevalent where the inhabitants drink melted snow water, as in Switzerland.

Mr. Titcomb: That would be strictly soft water.

Dr. Herrick: There is some cause, but we do not know what it is.

Mr. Marsh: I know that snow water used to be ascribed as a cause of goiter. I understand that goiter is known to be often waterborne and traced to wells, not necessarily snow water; but what it is in the water which causes the disease no one has declared, I think. Boiling corrects that water, however, I understand. Now I see Dr. Levin is here and he very likely can tell us something in particular about goiter in relation to water.

Dr. Isaac Levin, New York City: We do not know much more about the relationship between water and human goiter than what we know about the relationship between water and goiter in fish. It is a subject of which the proof is purely statistical. There is no pathological proof of the relationship between water and goiter; and whether there is an actual relationship is just as little known as the relationship between water and cancer to which you referred in your paper. It is also purely statistical, and this statistical evidence in medical matters, in matters of pathology, is not always of such a character that we can draw conclusions from it. We are not at all certain as yet that there is a real direct relation between the causation of goiter and water. So much the less do we know what there is in the water that is causing it.

SOME EXPERIMENTS IN THE BURIAL OF SALMON EGGS—SUGGESTING A NEW METHOD OF HATCHING SALMON AND TROUT

By John Pease Babcock

In writing of the propagation of salmon and trout some authorities state that considerable loss is occasioned in natural propagation by many of the eggs becoming imbedded in sand and gravel; that all the eggs so imbedded are lost.

Observation and experiment in the propagation of Pacific salmon and trout for a considerable period lead me to advance the theory that in natural propagation only those eggs which become imbedded beneath several inches of sand and gravel produce alevins which live to attain the fry stage; and that those eggs which are not covered by several inches of sand and gravel are either consumed by active aquatic enemies or destroyed by the vegetable moulds commonly termed "fungus."

My experiments have demonstrated that the burial of freshly fertilized eggs of the *nerka* and other Pacific salmon does not smother them; that eggs so treated not only live but hatch, and that if they are covered to a sufficient depth the alevins produced survive and possess the instinct and power to work their way gradually to the surface; that if buried beneath five or six inches of sand and gravel such eggs will hatch, and the young will work their way up through the sand and gravel to the surface, and that by the time they emerge have absorbed their sacs and are then exempt from the attacks of vegetable moulds.

Eggs buried under one or two inches of sand and gravel produce alevins that work their way up to the surface before the sac is absorbed, and upon reaching the surface are subject to attack by vegetable moulds, and a very large percentage are thus destroyed, as well as by the more developed forms of aquatic life.

Eggs buried to a depth of three inches produce alevins that work their way to the surface so gradually that by the time they reach the surface their sacs are so nearly absorbed that many, but not all, resist the effects of fungus. Alevins from eggs buried beneath less than four inches of sand are liable to reach the surface while the sac is so thinly covered that few if any survive the effects of fungus growth.

The spawning beds of Pacific Coast streams from California to Alaska (to which my observations have been confined), where the salmon spawn in numbers are, during and after the spawning period, covered with more or less vegetable moulds. These moulds are particularly common in the beds of streams where great numbers of salmon have spawned and died. Every experienced fish culturist knows that most waters carry great numbers of spores of fungi, and how difficult it is to prevent eggs and alevins from being attacked and injured by their growth. I believe that in natural propagation fungus growths destroy more salmon eggs and alevins than all other causes combined. The vegetable moulds of Pacific streams are not active beneath the surface of the beds of streams. Salmon eggs cast therein, if even thinly covered with sand, are not injured by them. These moulds do not affect fry that have nearly or entirely absorbed their sacs, but they are deadily if permitted to attach themselves to either the eggs or the alevins.

My experiments along this line lead me to express the opinion that by the burial of freshly fertilized salmon eggs under six or seven inches of sand and gravel strong healthy fry can be produced at less cost than under existing hatching methods, and that fry so produced are stronger and more capable of resisting the attacks of their active enemies.

I trust that this short statement of my experiments in the burial of salmon eggs may be deemed of sufficient economic importance to stimulate fish culturists generally in experimenting along similar lines. Those who do will perhaps experience some difficulty at first in the covering of a large number of eggs. Experimenters will find that after preparing suitable beds of sand and small gravel the eggs can be evenly laid and held until covered if the surface of the bed is first thickly indented with cells a little deeper than the eggs. This can readily be accomplished by stamping the bed with a board covered with projections or pegs of suitable size.

My experiments suggest that in the near future most of the buildings and hatching apparatus now used in the propagation of salmon and trout will be dispensed with; that after the eggs have been expressed and fertilized, instead of being placed in wire baskets in hatcheries, they will be buried beneath the sand and gravel of the beds of natural or prepared streams, and that with the exception of watchmen to protect them little or no other labor will be required.

SOME GENERAL REMARKS ON FISHING FOR SPORT

By H. Wheeler Perce

As I glanced at the preliminary announcement of this notable occasion I was moved to the thought that almost anything I could say would seem frivolous in view of the splendid intellectual feast that is spread before you.

The titles of the papers indicate a most magnificent amount of research and the great names that confront one in this program are an absolute promise of the best that can be produced by the best brains of the best of mankind.

But, after all, sport fishing is not a frivolous subject and should not be so considered, for it contributes in a very large measure to the happiness of a great many people, and the chief desideratum in life is happiness. The wise fathers, when they builded the fundamental documents of this Government so thought, for Thomas Jefferson positively assumes mankind entitled to the right to the pursuit of happiness. Note, he said nothing of its capture, which was a further indication of his great wisdom, for it is probably realized by those of us who have reached middle age that in the pursuit lies the real joy and that the capture or culmination comes but seldom.

It is something to be thankful for that this is probably not exactly true in the case of the angler. While there is no denying that the preparation for a fishing trip, the traveling toward favored water, and the skillful manipulation of his weapons, together with the charm of his surroundings make up a state of happiness for the angler, it still remains probably true that the lifting of his prize in the landing net —the capture—constitutes in his case the attainment of happiness, and hence the angler has exceeded the assumption of Jefferson in the Declaration of Independence and not only pursues happiness but catches it.

The psychological reasons why the pursuit and capture of game fishes should constitute happiness are probably too deep or involved for our most learned philosophers to determine. Many theories are advanced but none seem to actually solve the problem. However, any one of them is good enough for our purpose. The fact remains that a great number of people attain a great amount of personal gratification through the pursuit and capture of game fishes.

The sport has its detractors, those who sneer openly and call it foolishness, and those who negatively oppose it by a non-appreciation but are kind-hearted enough not to belittle it and those who condemn it as a mere lust for killing. But so long as mankind kills in order that he and his may eat, this latter seems flimsy sentimentality.

Sport fishing has its place and its uses in the world as has architecture, painting, sculpture or music, for all of these at their best are but the expressions of man's effort toward attaining happiness. Architecture speaks to him primarily as needed shelter from the elements, but secondarily as a gratification to the eye and to the demands of the soul for proportion and outline. Painting and sculpture tell him stories that play in one way or another upon his imagination and his emotions, and music sings to him her great songs of love, of sorrow, of triumph, of achievement; the sum total of its mission being to bring betterment to mankind.

Does not sport fishing bring to its devotee as much of good as do these great arts? Does it not bring to his soul surcease from care? Does it not bring to his body health and refreshment? Does it not bring to his eye beauties even more enthralling than those portrayed on canvas or carven in Carrara marble, and does it not bring to his ears music as sweet as the artist has ever drawn from his instrument? True, it may be humbler in a way than these splendid things, but it is none the less a blessing to those fortunate enough to be so constituted that they seek its pleasures.

In what way can the care-racked man find greater rest than by the side of some beautiful trout stream? Where can he see a more gorgeous canvas than the Almighty paints for him in a wondrous sunset seen across and reflected in the calm bosom of some lovely lake? What image carved from marble or cast with consummate skill in everlasting bronze can equal the majestic beauties graven in the face of the mighty mountains? What lullaby ever sung was sweeter than the ripple of a brook? Where can sound be found more inspiring than the diapasons of the insurging sea or the crashing symphony of the tempest? What jewel gleams with greater brilliancy to the eye of the angler than does the iridescent leaping trout?

To come to more material things, we find in sport fishing a health-giving pastime, much to be preferred to drugs and nostrums, and in these enlightened days the doctor's prescription begins to call more and more for fresh air and less and less for quinine. It is true, this can be said of all outdoor recreations, and it is very far from me to ascribe anything but virtue to any form of sport or play which takes a man into the open.

From a strictly commercial standpoint, sport fishing is of very much more than ordinary importance. It takes but a moment to realize how vast an amount of money is invested in enterprises connected with angling. Factories of no mean proportions employing many hands are devoted to the production of tools of the craft and great mercantile establishments all over the land cater to the wants of the angler. Hotels, both great and small, that derive their support from the angling fraternity abound in hundreds of localities. Thousands of boats are built and marketed yearly and in transportation alone thousands of dollars are spent. This all means a great contribution to the commercial activities of our country and adds to those conditions which stand for commercial supremacy and spell commercial success.

The mere gaining of dollars does not seem to me to be righteously the chief aim of man, but be that as it may, no one has yet found a better basis for general happiness than sound, progressive, honorable, business activity and assuredly any health-giving, legitimate sport that contributes as largely to those conditions as does angling is worthy of being considered important, and with this in view I am moved at this time to appeal for a more thoughtful consideration for sport fishing, as such, on the part of those who are engaged in the very honorable vocation of purely commercial fishing.

There has always seemed to be more or less friction between the differing interests. Never of a very serious nature, as far as I have observed, except in isolated cases, but a seeming lack of appreciation on the part of each for the rights of the other.

When the angler gives thought to the commercial side of fishing, he must, and in most cases does, realize the vast importance of this ancient and honorable business, one that is positively mighty in its ramifications and which probably contributes more toward the sustenance of the people than any other one food-producing industry.

Let it be asked of the commercial fisherman that he realize as fully the importance of sport fishing. Not that the latter is of such great proportions or of so great a value to the world at large as commercial fishing, but that it possesses in itself an importance that warrants its existence and the support of all those having the general welfare of mankind at heart.

Allowing that some considerable importance attaches to sport fishing and that a maintenance of those conditions which permit agreeable and successful participation in sport fishing is much to be desired, it is therefore assuredly meet that in the great and very general movement now going forward toward the conservation of our natural resources, that sport fishing should be considered.

It is, of course, very gratifying to know that much has been done and much is being done. There are many men in this assembly to whom the angling fraternity owe the deepest debt of gratitude for much work nobly and efficiently performed. Men whose names have found lodgment in the hearts of those who have learned to honor and esteem their owners for their splendid achievements.

As is true, I presume, of almost all progressive movements, great difficulties and complications confront every effort for the continued upbuilding and betterment of angling conditions. But the fact remains that day by day better things are being brought about, and it seems to me that this is being accomplished by "keeping everlastingly at it," if you will pardon the platitude.

Apparently the greatest difficulty that confronts us in establishing ideal conditions from the standpoint of an angler, is, to a certain degree, a lack of cohesion on the part of the various interests. Our country is so large that it seems almost impossible to bring into one unit of action all those who at heart desire exactly the same results. Efforts are being made here and there in localities remote from each other. Different states have differing laws and there appears to be no settled line of action. In many instances there seems almost a conflict of opposing forces.

Right here I wish to state as emphatically as I know how to put it that, in my opinion, the one, most radical, un-American, unnecessary and unseemly factor that brings about this lack of unity is the non-resident license law wherever it exists. It is a hand raised against a brother, and its operations should be abhorrent to every man who loves the Stars and Stripes.

A rod license in itself is a most estimable provision, but oh! the inhospitality, the selfishness and altogether contemptible spirit of a non-resident distinction. Who can hope for the achievements that unity of action can accomplish, when one factor in the entirety says to another, "you shall not enjoy what I have," and the other responds, "keep off of my preserve."

If I am rightly informed, every state in the Union is a suppliant to Uncle Sam for his largess in the way of game fishes, and still, in some instances, they turn to their neighbors and refuse them equal privileges with themselves. Every state that discriminates against the non-resident should be refused any favors or assistance at the hands of the government.

I am not versed in constitutional law, and they tell me some promulgated ideas of what the United States might do in relation to the conservation, preservation, etc., of game fishes would be unconstitutional, but assuredly a way can be found for the government to righteously administer in the premises.

Is a national rod tax out of the question and would not this give the government the right to control and hence bring about universal conditions of good, and laws backed by an efficient policing for which the lawbreaker would have some respect?

State laws, with very few exceptions, are, as I have said before, selfish and tend toward a breaking up of any proper appreciation of their righteousness and are often inoperative because of no proper respect for them or from a lack of funds to support the necessary officers calculated to compel such respect.

Would it not also be possible to still further the advancement of all those conditions for which the intelligent angler stands, to bring about a coalition of all or at least many of the organizations now devoted to this end. In such an organization would surely lie immense strength.

The National Association of Scientific Angling Clubs, of which I have the honor to be president, and which now embraces about twenty affiliated clubs and aggregates an individual membership of about twelve hundred, hopes to bring about, through its common interest in the sport of tournament casting, a very closely knit organization standing for the same general principles of sportsmanship and for those higher ideals and conditions for which all true anglers stand.

On the same principle could not a great national organization with ramifications in every state be formed out of the lesser organizations now in existence and an immense power for good thus established?

I have taken more of your valuable time than my abilities warrant, and I can but thank you for such consideration as you may give to this, at best, but rambling dissertation.

THE NORTH ATLANTIC FISHERIES DISPUTE AND ITS ARBITRATION AT THE HAGUE 1910

By Hugh M. Smith

An international fishery event of great interest and importance to the United States, Canada, and Newfoundland was the settlement in 1910 by arbitration of the long-standing differences between the United States and Great Britain growing out of ambiguities in the treaty defining the rights of American fishermen on the coasts of British North American colonies.

The treaty of peace between the United States and Great Britain in 1783 had as its third article the following:

> It is agreed that the people of the United States shall continue to enjoy unmolested the right to take fish of every kind on the Grand Bank, and on all the other banks of Newfoundland; also in the Gulph of Saint Lawrence and at all other places in the sea where the inhabitants of both countries used at any time heretofore to fish. And also that the inhabitants of the United States shall have liberty to take fish of every kind on such part of the coast of Newfoundland as British fishermen shall use (but not to dry or cure the same on that island) and also on the coasts, bays and creeks of all other of His Britannic Majesty's dominions in America; and that the American fishermen shall have liberty to dry and cure fish in any of the unsettled bays, harbours and creeks of Nova Scotia, Magdalen Islands and Labrador, so long as the same shall remain unsettled; but so soon as the same or either of them shall be settled, it shall not be lawful for the said fishermen to dry or cure fish at such settlements, without a previous agreement for that purpose with the inhabitants, proprietors or possessors of the ground.

After the close of the War of 1812, the question arose as to whether the fishery provisions of the treaty of 1783 had been abrogated by the war. Great Britain contended that this part of the treaty was no longer in force, the United States refused to agree to such a contention. With the two governments thus assuming opposite views on the question, the prosecution of the fisheries necessarily led to more or less serious conflicts of authority and weighty diplomatic conference and correspondence, the outcome of which was the negotiation and adoption in 1818 of a new treaty. The important article of this treaty was as follows:

Whereas differences have arisen respecting the Liberty claimed by the United States for the inhabitants thereof, to take, dry and cure fish on Certain Coasts, Bays, Harbours, and Creeks of His Britannic Majesty's Dominions in America, it is agreed between the High Contracting Parties, that the inhabitants of the said United States shall have forever, in common with the Subjects of His Britannic Majesty, the Liberty to take fish of every kind on that part of the Southern Coast of Newfoundland which extends from Cape Ray to the Rameau Islands, on the Western and the Northern Coast of Newfoundland, from the said Cape Ray to the Quirpon Islands, on the shores of the Magdalen Islands, and also on the Coasts, Bays, Harbours and Creeks from Mount Joly on the Southern Coast of Labrador, to and through the Straights of Belleisle and thence Northwardly indefinitely along the Coast, without prejudice, however, to any of the exclusive Rights of the Hudson Bay Company: And that the American fishermen shall have liberty forever, to dry and cure fish in any of the unsettled Bays, Harbours and Creeks of the Southern part of the Coast of Newfoundland hereabove described, and of the Coast of Labrador; but so soon as the same or any portion thereof, shall be settled it shall not be lawful for the said Fishermen to dry or cure Fish at such Portion so settled, without previous agreement for such purpose with the Inhabitants, Proprietors, or Possessors of the ground. And the United States hereby renounce forever, any Liberty, heretofore enjoyed or claimed by the Inhabitants thereof, to take, dry or cure Fish on, or within three marine Miles of any of the Coasts, Bays, Creeks or Harbours of His Britannic Majesty's Dominions in America not included within the abovementioned limits: Provided, however, that the American Fishermen shall be admitted to enter such Bays, or Harbours for the purpose of Shelter and of repairing Damages therein, or purchasing Wood, and of obtaining Water, and for no other purpose whatever. But they shall be under such Restrictions as may be necessary to prevent their taking, drying or curing Fish therein, or in any other manner whatever abusing the Privileges hereby reserved to them.

Although the express object of this treaty was the definition of the rights of United States fishermen on the coasts of Canada and Newfoundland, it afterwards transpired that those rights were still unsettled and uncertain; and for over ninety years the matter remained a source of annoyance, contention, bad feeling, and conflict, until the responsible authorities of the two nations chose an opportune time and arranged for the settlement that happily has now been consummated.

Under an agreement signed at Washington on January 27, 1909, by Ambassador James Bryce and Secretary Elihu Root, it was agreed to submit certain fishery questions to a tribunal of arbitration, in accordance with the terms of the general treaty of arbitration concluded between the United States and Great Britain in 1908. The case is noteworthy as being the first to arise under that treaty, and therefore marks an epoch in the world's history. The questions which the arbitration court was asked to decide, and which covered all the main points in dispute, were as follows:

Question 1.—To what extent are the following contentions or either of them justified?

It is contended on the part of Great Britain that the exercise of the liberty to take fish referred to in the said Article, which the inhabitants of the United States have forever in common with the subjects of His Britannic Majesty, is subject, without the consent of the United States, to reasonable regulation by Great Britain, Canada, or Newfoundland in the form of municipal laws, ordinances, or rules, as, for example, to regulations in respect of (1) the hours, days, or seasons when fish may be taken on the treaty coasts; (2) the method, means, and implements to be used, in the taking of fish or in the carrying on of fishing operations on such coasts; (3) any other matters of a similar character relating to fishing; such regulations being reasonable, as being, for instance—

(a) Appropriate or necessary for the protection and preservation of such fisheries and the exercise of the rights of British subjects therein and of the liberty which by the said Article I the inhabitants of the United States have therein in common with British subjects;

(b) Desirable on grounds of public order and morals;

(c) Equitable and fair as between local fishermen and the inhabitants of the United States exercising the said treaty liberty and not so framed as to give unfairly an advantage to the former over the latter class.

It is contended on the part of the United States that the exercise of such liberty is not subject to limitations or restraints by Great Britain, Canada, or Newfoundland in the form of municipal laws, ordinances, or regulations in respect of (1) the hours, days, or seasons when the inhabitants of the United States may take fish on the treaty coasts, or (2) the method, means, and implements used by them in taking fish or in carrying on fishing operations on such coasts, or (3) any other limitations or restraints of similar character—

(a) Unless they are appropriate and necessary for the protection and preservation of the common rights in such fisheries and the exercise thereof; and

(b) Unless they are reasonable in themselves and fair as between local fishermen and fishermen coming from the United States, and not so framed as to give an advantage to the former over the latter class; and

(c) Unless their appropriateness, necessity, reasonableness, and fairness be determined by the United States and Great Britain by common accord and the United States concurs in their enforcement.

Question 2. Have the inhabitants of the United States, while exercising the liberties referred to in said Article, a right to employ as members of the fishing crews of their vessels persons not inhabitants of the United States?

Question 3. Can the exercise by the inhabitants of the United States of the liberties referred to in the said Article be subjected, without the consent of the United States, to the requirements of entry or report at custom-houses or the payment of light or harbour or other dues, or to any other similar requirement or condition or exaction?

Question 4. Under the provision of the said Article that the American fishermen shall be admitted to enter certain bays or harbours for shelter, repairs, wood, or water, and for no other purpose whatever, but that they shall be under such restrictions as may be necessary to prevent their taking, drying, or curing fish therein or in any other manner whatever abusing the privileges thereby reserved to them, is it permissible to impose restrictions making the exercise of such privileges conditional upon the payment of light or harbour or other dues, or entering or reporting at custom-houses or any similar conditions?

Question 5. From where must be measured the "three marine miles of any of the coasts, bays, creeks, or harbours" referred to in the said Article?

Question 6. Have the inhabitants of the United States the liberty under the said Article or otherwise to take fish in the bays, harbours, and creeks on that part of the southern coast of Newfoundland which extends from Cape Ray to Rameau Islands, or on the western and northern coasts of Newfoundland from Cape Ray to Quirpon Islands, or on the Magdalen Islands?

Question 7. Are the inhabitants of the United States whose vessels resort to the treaty coasts for the purpose of exercising the liberties referred to in Article I of the treaty of 1818 entitled to have for those vessels, when duly authorized by the United States in that behalf, the commercial privileges on the treaty coasts accorded by agreement or otherwise to United States trading-vessels generally?

Some of the most conspicuous personages in our diplomatic and political history have been officially concerned with this fishery question; and some of the ablest of American state papers have related thereto. The treaty of 1783 was negotiated by John Adams, Benjamin Franklin, John Jay, and Henry Laurens. The treaty of 1818, which revived the treaty of 1783 in modified form, was negotiated by Albert Gallatin and Richard Rush.

Among the other American ministers and ambassadors at the court of St. James and distinguished special commissioners and plenipotentiaries abroad who became actively involved in the fishery negotiations and correspondence were John Quincy Adams, Henry Clay, William Pinkney, Edward Everett, Charles Francis Adams, James Russell Lowell, Edward J. Phelps, and Whitelaw Reid.

American secretaries of state who forcefully enunciated the American position on the various phases of the controversy and strenuously asserted the rights of our fishermen included James Monroe, Martin Van Buren, John C. Calhoun, James Buchanan, Daniel Webster, Edward Everett, W. L. Marcy, William H. Seward, Hamilton Fish, William M. Evarts, Thomas F. Bayard, and James G. Blaine.

In the history of this long-standing dispute, the two names that will always be most conspicuous because of the important part these men played in preparing the way for adjustment by arbitration are Sir Edward Grey, the British Secretary of State for Foreign Affairs, and Honorable Elihu Root, American Secretary of State, and later chief counsel for the United States before the court of arbitration.

The arbitration proceedings began at The Hague on June 1, 1910, and continued until September 7, 1910, when the award was announced. The court, by agreement, consisted of five members of the permanent court of arbitration at The Hague, and its personnel was as follows:

Dr. H. Lammasch, doctor of law, professor of the University of Vienna, aulic councilor, member of the upper house of the Austrian Parliament.

His Excellency Jonkheer A. F. de Savornin Lohman, doctor of law, minister of state, former minister of the interior, member of the second chamber of the Netherlands.

The Hon. George Gray, judge of the United States Circuit Court of Appeals.

The Right Hon. Sir Charles Fitzpatrick, doctor of law, chief justice of Canada.

Mr. Luis Maria Drago, doctor of law, former minister of foreign affairs of the Argentine Republic.

The presentation of the contentions, views, and claims of the two nations was submitted to the court in printed form before the formal opening, and was of a most elaborate character. On behalf of the United States, the agent, Hon. Chandler P. Anderson, prepared for the information of the court six volumes embodying "The Case of the United States," with two appendices, "The Counter Case of the United States," with appendix, and "The Argument of the United States," the series comprising over 2,500 printed pages. For Great Britain a similar duty devolved on the agent, Hon. Allen B. Aylesworth, and the amount of matter thus prepared was about equal to that for the United States.

The principal part of the proceedings was taken by the oral argument, which consumed forty sessions and were delivered by four of the counsel for Great Britain and four for the United States. The concluding arguments were by Sir William Robson, Attorney-General of Great Britain, and Senator Elihu Root. The sessions were held in the historical Hall of the Knights, and were open to the public.

The most important matter submitted to the tribunal and covered by the award was that represented by Question 1, inasmuch as the sovereignty of Great Britain was involved on one hand and the practical exercise of the fishing rights by Americans on the other. The tribunal therefore went most deeply into the controversy, and rendered an opinion that was in a measure a compromise.

The court decided (1) that the right of Great Britain to make regulations without the consent of the United States, as to the exercise of the liberty to take fish under the treaty, in the form of municipal laws, ordinances, or rules of Great Britain, Canada, or Newfoundland is inherent in the sovereignty of Great Britain; (2) that in the exercise of that liberty the regulations must be made bona fide and must not be in violation of the treaty; (3) that such regulations must be (a) appropriate or necessary for the protection and preservation of the fisheries, or (b) desirable or necessary on grounds of public order or morals without unnecessarily interfering with the fishery itself, and (c) equitable and fair as between local and American fishermen, and not so framed as to give unfairly an advantage to the former over the latter class; (4) that in case of a difference of opinion between the two nations as to the reasonableness of any existing fishery regulation made by Great Britain, Canada, or Newfoundland, the decision must be made by an impartial commission of expert specialists, in accordance with the terms of the special agreement, the commission to consist of one non-national member to be designated by the court and of one member to be designated within one month by each of the parties to the arbitration; (5) that the unanimous opinion of this commission or the opinion of the non-national member in case of dispute is recommended for acceptance of the parties, in lieu of a reconvening of the court; (6) that all future municipal laws, ordinances, or rules for the regulation of the fishery in respect to (a) the hours, days, or seasons when fish may be taken on the treaty coasts, (b) the methods, means, and implements used in taking fish or in conducting fishing operations, (c) any other matters of a similar character, shall be published in the respective official gazettes of Great Britain, Canada, or Newfoundland at least two months before becoming effecive; (7) that if the United States government considers any such laws or regulations inconsistent with the treaty of 1818, they shall not come into effect so far as the inhabitants of the United States are concerned until approved by a permanent mixed fishery commission, composed of one expert on behalf of the United States, one on behalf of Canada, and one on behalf of Newfoundland, together with an umpire commissioner to be named by the two nations or, in the event of their failure to agree, by the Queen of the Netherlands.

In accordance with the terms of this part of the award, the court named as the non-national member of the expert commission to pass on the existing fishery laws and regulations, Dr. P. P. C. Hoek, scientific fishery adviser of the Dutch Government and an honorary member of the American Fisheries Society; and within the time specified the British Government named as its representative Hon. Donald Morison, minister of justice of Newfoundland, and the United States Government nominated Dr. Hugh M. Smith, deputy fish commissioner.

The principal issue in Question 2 was whether American fishing vessels intending to operate on the treaty coasts might sail from the home port with skeleton crews and then take on board in Canadian or Newfoundland ports enough men to fill out their complement. The award was that inhabitants of the United States, while exercising their liberties under the treaty, have he right to employ, as members of the fishing crews of their vessels, persons not inhabitants of the United States.

With regard to Question 3 the court held that an American fishing vessel while exercising its rights under the treaty should report at the custom-house if the proper conveniences for doing so are at hand, but not otherwise, and that the fishing liberty should not be subjected to the purely commercial formalities of report, entry, and clearance at a custom-house, nor to light, harbor, or other dues not imposed upon Newfoundland fishermen.

Question 4 is closely related to Question 3, and the award thereunder is the same. That is, American fishing vessels entitled under the treaty to enter certain bays or harbors for shelter, repairs, wood and water, and for no other purpose whatever, are not liable to have the exercise of this privilege made conditional on the payment of light, harbor, or other dues or on the entering at custom-houses.

A very interesting and important international point, that has caused much friction between Canada and the United States, is the proper way in which to measure the three-mile limit with respect to bays. Question 5 was therefore one of the major subjects coming before the tribunal, and was given much attention by counsel and court. The principle laid down in the award is that the three marine miles are to be measured from a straight line drawn across the body of water at the place where it ceases to have the configuration and characteristics of a bay, and that at all other places the three marine miles are to be measured following the sinuosities of the coast. The extreme position taken by Great Britain—that bays are to be defined by lines drawn from headland to headland—was not sustained; but the contention of the United States—that in the absence of other expressed and acknowledged claims of sovereignty bays are to be regarded as indentations which are six miles or less in width at their mouth or are to be regarded as beginning where the sides of indentations approach within six miles of each other—was likewise overruled.

Question 6, submitted at the request of the Newfoundland government and addressed to the vital point whether United States fishermen really were entitled to the liberties they had always enjoyed of taking fish in the bays, harbors, and creeks on the coasts of Newfoundland and on the Magdalen Islands, was readily answered by the court in the affirmative. This decision is very important because of the fact that the Newfoundland government, in the event of an award favorable to its contention, was preparing to present a claim for large damages for the value of all the fish taken by American vessels in the bays of that colony during the past ninety years.

The final question took cognizance of certain practices that had grown up in recent years on the coast of Newfoundland. The court held that United States fishing vessels when resorting to the treaty coasts for the purpose of exercising their rights under the treaty may, when duly authorized by the United States Government, also enjoy the commercial privileges accorded to United States trading vessels generally, provided that the liberty of fishing and the privilege of trading are not exercised concurrently.

It is a noteworthy and significant fact that the award of the court on all the numerous and weighty matters involved was unanimous, with the exception that Mr. Drago rendered a dissenting opinion on the fifth question.

Epitomizing the results of the award, it appears that Great Britain received the decision on Question 1, and benefitted rather more than the United States on Question 5. On all of the other five questions the award favored the United States; and on Question 1, although the United States' contention as to the proper interpretation of the treaty was not sustained, this country gained all the desired objects by virtue of the provision of the special agreement by which local laws and regulations not approved by the United States Government are to be submitted to an expert commission.

FIVE YEARS' PROGRESS IN FISH CULTURE IN ARGENTINA

BY E. A. TULIAN

During the five years of the work of the section of fish culture of the Argentine Department of Agriculture, from March 1, 1904, to April 1, 1909, it has imported from the United States, England, and Germany a total of 4,260,400 developed fish eggs of the following species and in the following numbers:

Whitefish	1,000,000
Quinnat salmon	900,000
Brook trout	587,700
Lake trout	482,000
Blueblack salmon	326,500
Silver salmon	288,200
Steelhead trout	253,000
Rainbow trout	232,000
Landlocked salmon	140,000
Atlantic salmon	45,000
European brown trout	6,000
	4,260,400

During the years 1906, 1907, and 1908 the Nahuel Huapi and Santa Cruz hatcheries collected a total of 650,640 brook trout eggs from brood fish which are being reared at these places. The fish at the Santa Cruz Station spawned for the first time in 1908, hence the supply of eggs collected there was very small. It is expected that more than 500,000 to 800,000 eggs will be collected from brood trout at the Nahuel Huapí, Santa Cruz and La Cumbre hatcheries this year. The brood fish at La Cumbre are spawning this year for the first time and the number collected there will be small, especially as the La Cumbre hatchery is only a temporary one, and the water supply so limited that at best only a few fish can be reared.

From September 30, 1904, to October 31, 1908, about 500,000 pejerrey eggs were collected, mostly at Lake Chascomus, and from these 343,050 developed eggs and young fish have been distributed. Owing to the prohibition of fishing in Lake Chascomus since early in 1906, it has been impossible to extend the pejerrey operations, and the time and money that under favorable circumstances might have been profitably employed in this branch of the work, have been devoted to operations which would bring a more certain return. In addition to the trouble of securing an adequate supply of eggs to compensate for the expenditure of time and money, obstacles were encountered from the fact that the pejerrey is probably the most difficult fish to propagate artificially. Some fishes cannot be artificially propagated by any of the methods known to modern fish culture, and the pejerrey is closely similar to these species in this respect.

From the 4,260,400 fish eggs imported into this country there have been hatched 3,545,870 fish; thus the loss on the entire lot of eggs from the time they were packed at the different hatcheries in the United States, England, and Germany until they had finished hatching at the different hatcheries in Argentina has been but 714,530 eggs, or considerably less than 17 per cent. Many of the eggs were brought from the most distant points in the United States, often from the Pacific Coast, and were in the packing cases from 50 to 80 days.

The brook trout planted from the La Cumbre hatchery in 1907 in the headwaters of the Rio San Miguel and tributaries, Rio Carappe and tributaries and in the head waters of the Rio Cosquin and tributaries, all in the Province of Cordoba, have given splendid results, many trout from 30 to 35 centimeters long having been seen in these waters by myself and many other people when the fish were but one year old. One small lot of 200, only 5 to 8 centimetres long, planted in the Lumsdaine Dique at Cruz Chica near La Cumbre, resulted in 180 fish from 25 to 30 centimeters long when they were but one year old, although they had been given no attention by practical fish culturists and subsisted only on the natural food found in the pond.

Many steelhead and rainbow trout, planted in these and other waters in the Province of Cordoba from the La Cumbre hatchery in August, September, and October, 1908, have been seen and they were from 15 to 20 centimeters long when but 6 months old. Some specimens of the steelhead trout were taken from the rearing pond at the La Cumbre hatchery, by the chief of this section and the "ayudante" in charge of the station, which were from 24 to 27 centimeters long when less than nine months old. Good reports have been received concerning steelhead and rainbow trout planted in one lake at the head of the Rio Yala in the Province of Jujury. Dr. Victor Vargas, the owner of these lakes, wrote me that he had seen many of the trout and they were 15 to 20 centimeters long. The letter was written when the fish were six months old. Robert M. Smyth, Esq., manager for Leach Hermanos at San Lorenzo, wrote that he had also seen some of the steelhead and rainbow trout planted in waters near there and that they were in good condition and growing rapidly. Nothing has been seen of the rainbow, steelhead and brook trout planted in the various rivers in the Province of Tucuman, but this was to be expected, as these rivers are very much larger than those in the Province of Cordoba, and it will be accordingly difficult to find the fish until they are a year or two old. The brook trout from the La Cumbre hatchery which were planted in the Arroyos de la Ventana and San Pablo and their tributaries, all in the Province of Buenos Aires, have given good results. Sir Rudolfo Funke, a prominent estanciero, reported in March, 1910, that he had recently seen large numbers of brook trout in the Arroyo San Pablo, and a considerable number in the Arroyo de la Ventana. Mr. Funke assured me that the fish which he saw were from 25 to 30 centimeters long, and that he was quite sure of their identity as he had often caught brook trout in Germany and other portions of Europe.

Early in May Mr. Funke came to see me again and told me he had recently observed these trout a number of times, and that he had also seen steelhead and rainbow trout which we had planted in the same waters from the La Cumbre hatchery in October, 1908, and that these last named trout were from 10 to 20 centimeters in length.

That the brook trout planted in the Rio Santa Cruz and tributaries in 1906 have prospered very well indeed there is no doubt. The second chief of this section caught two very fine specimens, male and female, from the Rio Santa Cruz below the hatchery in March of this year. These specimens were 30 and 34 centimeters long, respectively, and were in excellent condition. He also received reports that a considerable number of other trout had been taken from the Rio Santa Cruz at various times by people who were fishing with nets for the "trucha criolla" and pejerrey. The "ayudante" in charge of the hatchery at Santa Cruz wrote me under date of April 30, 1909, that a number of trout had recently been caught in the Rio Santa Cruz, and judging from the description given they were probably of the different varieties which have been planted from the Santa Cruz hatchery at various times during the past three years, namely, brook, rainbow, and lake trout. On the 20th of April he was shown one of the trout caught and he tells me it was a brook trout, and a very fine, healthy specimen, a female measuring 36 centimeters long and containing a large number of nearly mature eggs which he judged would be deposited about the middle of May.

Good reports of the work done by the Nahuel Huapi hatchery are being continually received, but I need mention only a few to show the success of the work there. About the last of December, 1908, the "ayudante" in charge of the station at Nahuel Huapi, wrote me that he had been at Lago Traful planting trout in the waters of that region, and that while there he had done some rod and reel fishing, using both artificial flies and minnows. One evening while using an artificial fly in the Rio Traful, about one league below the lake of the same name, he caught brook trout some 30 or more centimeters long, and one landlocked salmon 50 centimeters in length. He said further that he had seen a considerable number of brook trout at various places in the river. Some time later when fishing with an artificial minnow he hooked a very large fish which finally broke his line and disappeared with a portion of it, hook, minnow, and all. However, before the fish succeeded in breaking the line it had been hauled in close enough for him to get a fairly good view of it, and he believed it to have been a lake trout, knowing it was neither a "trucha criolla" nor a brook trout, and being almost positive that it was not a landlocked salmon. He did not state and I have not yet learned whether the fish which broke the line was hooked in the Rio Traful or in Lake Traful. Judging, however, from the fact that he was using an artificial minnow instead of an artificial fly, I am led to believe he was fishing in Lago Traful, and if so, I feel quite positive that the fish hooked was a lake trout. The only landlocked salmon, brook and lake trout planted in Lago Traful and waters in that vicinity, previous to last year, were put there by myself in May, 1904, hence the fish caught were results of this plant from the first lot of Salmonidæ ever brought to Argentina. The fact that this large landlocked salmon was caught and identified by the "ayudante" in charge of the Nahuel Huapi hatchery leads me to feel sure that the introduced fishes taken at various times from the Rio Negro between Chilforo and its mouth by net fishermen were landlocked salmon. If so, this will likely prove an easy means of populating suitable waters of Argentina with Atlantic salmon, which I have always thought feasible. It was partly with this idea that I had landlocked salmon brought to the country with every lot of eggs imported (excepting upon two occasions when they could not be obtained because of the season of the year).

Information relative to the introduced fishes mentioned above as having been taken from the Rio Negro between

Chilforo and its mouth was given to me verbally by the late Mr. Moncreif. According to this gentleman, while he was on expedition going down the river about the middle of the year 1908, the fishermen who fish with nets in the river told him at different times they had on various occasions caught strange fish with spots on fins and tails. I believe these fish to have been landlocked salmon, resulting from plants in Lakes Nahuel Huapi, Traful, Gutierrez, Correntosa, etc., early in 1904.

I might mention here that except the whitefish every species of fish hatched at the Nahuel Huapi hatchery early in 1904, and planted in the lakes and rivers and streams of that region, has been found and identified, and I am not at all discouraged because the whitefish has not been found, as I do not believe it has been fished for in the proper localities and under proper circumstances. The whitefish is rarely ever taken on a hook, and then only in very swift waters through some portion of a lake which it inhabits, and to catch it is the work of experienced fishermen with the proper kind of nets. The brook trout are propagating naturally in the streams in the Nahuel Huapi region, and large quantities of small fish from 5 to 8 centimeters long are annually taken from irrigating ditches and transferred to suitable waters by the "ayudante" in charge of the hatchery and his assistants, thus saving thousands of trout which would otherwise be lost by the drying up of these ditches later in the season when the water which flows through them is turned into other channels.

In a report written by the "ayudante" at the hatchery at Nahuel Huapi on May 14th of this year, he states that to date he had collected a total of 122,500 eggs during the month and that all but 26,000 of these eggs were from wild trout taken from the Rio Nirihuah, Arroyos, Cordoba, Chacabuco, Taylor, etc. A telegram from this same source on June 6th reported a total of 390,000 eggs collected to that date. It did not state the number taken from wild trout, but probably more than one-half were from this source, while the other 50 per cent were taken from the stock fish at the station. In May while fishing was in progress in the Rio Nirihuah for trout from which to collect eggs, one brook trout was caught measuring 48 centimeters in length, and weighing probably about two kilos or more. This fish was full of eggs. The same day a female landlocked salmon, measuring 43 centimeters was taken, but she had already deposited her eggs. A great many very fine trout and landlocked salmon have been taken at various times from the Rio Nirihuah.

We continue to receive reports which indicate the complete success resulting from the developed pejerrey eggs planted in various waters of the republic where no pejerrey existed. Some time ago, in January of this year, I believe, Mr. Schultz, of the Officina Meteorologica, told me that it was found necessary to remove the water from the small pond at their magnetic observatory at Pilar, and that when the pond was almost dry several specimens of pejerrey 15 to 20 centimeters in length were captured. These were the result of a small number of eggs planted in this pond in October or November of 1907. Early in May of this year I was told by Mr. M. G. Fortune, of San Martin 195, that he had been recently informed by Mr. David Ripley, of Buena Esperanza, that he (Mr. Ripley) had seen hundreds of pejerrey from 15 to 25 centimeters long in the laguna on his estancia, where he had planted a small number of pejerrey eggs furnished to him by this section, in October, 1907. Under date of November 20, 1908, Mr. Edmundo Wernicke, of the estancia "Don Roberto," Mercedes, Province of San Luis, wrote me that he had stocked many lakes in that province with pejerrey by taking the fish from his lakes in which I planted developed eggs in November, 1904. I quote the following from his letter: "When you return to your country you may be sure you leave many friends in the Province of San Luis who have never met you, but who know you through your work of having introduced the pejerrey into this section of the country. The people of the

Province of San Luis have you to thank for their pejerrey, etc."

While fish culture in this country has a very good start, it is yet in its infancy, and there still remains a vast amount of work to be accomplished in salmon and pejerrey propagation and distribution. Besides these there are other important branches to be taken up which will prove of equal, if not of greater value to this country. I have repeatedly called the attention of the superior authorities to the advantages to be derived from introducing the small-mouth and large-mouth black bass. These fishes and others of the same family would prove most valuable for stocking a vast area of waters in this republic, which average too warm and are not sufficiently clear for members of the salmon tribe. Pike perch (*Stizostedion vitreum*) would also prove a valuable addition to the waters of Argentina, as would likewise shad and striped bass.

That fish culture in the Republic of Argentina has a great future I am fully convinced.

NOTES ON FOREIGN FISH CULTURE AND FISHERIES*

MANURING PONDS

With the various views and experiences which have heretofore been published in your esteemed journal permit me to bring to general knowledge my own methods, which have in practice for some years proved themselves to be of the best. I own two nurse-ponds, of 2 and 3 hectares (5 to 7 acres) area respectively, whose water supply I can regulate at pleasure. They lie dry from the middle of October to the end of May. In April they are dressed with air-slacked lime and plowed about 9 inches deep. The bottom is humus, with a clay subsoil. The last of June I begin the application of human and animal excrement—not direct on the edges of the nurse-ponds, but in so-called crustacea-ponds, 15 to 20 qm. (150 to 200 sq. ft.) in area and about 1 meter (39 in.) deep which are located about 4 meters (13 ft.) above the nurse-ponds and communicate with them. In a short time—in warm weather 10 or 14 days—the water assumes a greenish color and these ponds swarm with life, of which I let some into the nurse-ponds at intervals of 8 days or so, according to the water temperature. Thereby, in my opinion, not only is the infecting of the water in the nurse-ponds prevented, but the fry find always a table set, and an exhaustion of the natural food in the pond is prevented. I cease supplying this food at the beginning of October. Last year I fished out in the seven-acre pond 65,000 carp yearlings 6 to 12 cm. (2½ to 5 in.) long. This year, unfortunately, 15 trout got in and the yield is therefore very small.—*Correspondent of "Fischerei-Zeitung" (Neudamm), November 13, 1909.*

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*Selected and translated by Mr. Charles G. Atkins and presented as the fourth report of the Committee on Foreign Relations of which Mr. Atkins is chairman.

COMMERCIAL FERTILIZERS FOR PONDS

If agricultural lands are treated with lime, Thomas-meal, kainit and saltpeter, then the cultivated plants can by means of their roots get lime, phosphoric acid, potash and nitrogen from the soil and grow luxuriantly. In water culture the biological process is somewhat different. In this case the plant food is taken up and elaborated by sundry species of algæ, especially the one-celled algæ that are in suspension in pond water, and serve as excellent food for the minute creatures that constitute the food of carp. These algæ have no roots and are therefore not able to extract plant food from the bottom of the pond. The swimming algæ get their nutrition from the water, and so the fertilizers to be used in pond work must be soluble in water.

As Thomas-meal contains phosphoric acid soluble only in citrates it is not available for water-fertilization. In the above-mentioned experiments the fertilizing of the potash, nitrogen and lime become available only so far as the soluble acid already naturally present in the water suffices for the growth of algæ. Instead of Thomas-meal let us in pond-culture use superphosphate which is decomposed by means of sulphuric acid. In such superphosphates the phosphoric acid is present in a form soluble in water, so that this plant food can be extracted from the water and appropriated by the algæ. We might also get water-soluble phosphoric acid in decomposed Peruvian guano. This contains, besides phosphoric acid, also nitrogen, lime and some potash. It is quite high in price and can without waste of the precious nitrogen, only be used in such ponds as have little or no humus. Some years ago in some poor ponds of this sort, after first liming the pond-bottoms, I used Peruvian guano with an addition of salts of potash, with entire success. That was a complete manuring, in which the leading plant foods were furnished in sufficient quantity for an enormous development of the suspended algæ. In most ponds water-soluble phosphoric acid is present in too small quantity and therefore a fertilization with superphosphates is especially to be recommended.

Potash can also be had in water-soluble form as well as in 40 per cent salts of potash and in about 14 per cent kainit. Both these fertilizers can be spread on the bottom before letting on the water or in the pond later.

In the use of nitrogenous fertilizers in pond-culture the greatest care is enjoined. Most pond-floors have naturally a pretty high nitrogen-content. There are often great masses of humus accumulated, and for the pond-culturist it only remains to make this store of nitrogen active. The means to this end are:

1. Thorough drainage and deoxidation for the pond-bottom, since water and humic acids are antiseptic in their influence.

2. Laying the pond completely dry during the winter, to crumble the bottom.

3. Liming of the pond, to induce a more rapid decomposition of the humic constituents of the bottom and a chemical fixation of the pernicious humic acids.

In feeding-ponds there is at first no nitrogenous manuring necessary since the nitrogenous content of the food, generally abundant, is only partly digested by the fish, and the undigested remnant suffices for the fertilization of the water. Only in case of ponds poor in humus without sufficient fructifying flooding from outside, is a trial of fertilization with water-soluble nitrates to be advised.

The liming of the pond should not be omitted on earths containing little or no lime, for reasons already given, and also because the lime is an important constituent of plants, indispensable to suspended algæ; not to mention the destructive influence of the quicklime or burnt lime on the disease-inciters and parasites in the pond. If burnt lime is used for pond fertilization, wait at least fourteen days after its application. Ponds occupied by fish should be dressed only with ground lime-carbonate to avoid endangering the fish.

How much of each kind of commercial fertilizer should be used under different circumstances cannot be exactly prescribed. The demand depends upon the character of the pond and that is, as all know, of the greatest variety. The material presumed to be necessary (superphosphate, lime, potash and later nitrogen) must absolutely be in the pond together when it is filled, that the algæ may find all necessary aliments, dissolved in the water, in sufficient quantity at the same time. So soon as any one of the leading ingredients in the pond is used up, the increase of the algæ and with it the production of food-animals and carp-flesh comes to a standstill. So it would be a mistake to fertilize, say, one year exclusively with lime, next summer with superphosphate and the third year with potash.

That ponds which are to receive a fertilizing of the bottom or of the water must be free from litter and that no water must flow through them is plain from reasons stated above.

By continued water-fertilization, no matter whether it is done with liquid manure, stable manure, etc., or with suitable commercial fertilizers, the fish culturist endeavors to produce by artificial means the conditions of village ponds, that is, to work the ponds up to the highest possible natural growth. This, however, would not be a complete success, and will not be reached until these good ponds are heavily stocked and the fishes fed accordingly. The more algæ and food-animals a pond produces, the better fitted it is for intensive feeding, and the more favorable results will this feeding yield. Rich fertilization and correct feeding must be the watchword in pond-culture.—*Instructor Behringer, in "Journal of the Agricultural Society of Bavaria."*

CARP CULTURE IN FRANCE

In the vicinity of Paris it is generally about the first of June that the carp spawns. But the date varies a great deal, according to atmospheric conditions; a cold spring retards it, just as untimely heat may accelerate it. Actually this species spawns when the water has attained a temperature of about 20° centigrade (68° F.). It is to be remarked, however, that carp do not all spawn at the same time. Those six or seven years old spawn much later than younger fishes—that is to say, not until July, or even August, long after the others are through. This explains how last season fry were frequently found of two distinct sizes—a fact that has led some breeders to believe that the carp may spawn twice in succession the same season when meteorological conditions are favorable. This is an error of observation. Fry of good size in autumn come from the spawning of young fish which spawn about the end of May or beginning of June, while very small fry, which are found mixed with the others, come from eggs laid in August by very old carp.

Ten days are enough in warm weather to effect the hatching of the eggs, and the fry develop pretty rapidly when they find sufficient nourishing food. Nevertheless, even those hatch very early, that is to say, in the first days of June, and transported under favorable conditions, hardly measure more than 3 or 4 centimeters (1¼ to 1⅜ in.) in length at the utmost. At this age, and even much later in the season, they are liable to be destroyed in large numbers by ducks, which it is therefore important to keep out of the waters occupied by fry. These palmipedes are also harmful at the spawning of the fish. Indeed, having the habit of dabbling along the shores, where the carp generally spawn, of diving to the bottom and digging in the mud, they are a continual detriment to the waters that they frequent; little by little the muddy cloud settles on the submerged aquatic plants, soon covering the carp eggs adhering to these herbs with a layer of sediment impermeable to the air, and the embryos are smothered and perish for want of oxygen.

The pike is very often used in ponds to prevent too great an abundance either of carp fry or of "white fishes" (bleak, roach, etc.), the swarms of which may appropriate too great a proportion of the fish-food, to the detriment of the market carp, which, in consequence, are thus hindered from developing well and attaining soon enough the marketable size.

But other carnivorous fishes can just as well be employed to do the same work. When a pond is in question where waters are not habitually disturbed and not subject to too extended droughts during the high summer temperatures, above 24° or 25° centigrade (75° or 76° F.), for the pike substitute with profit the rainbow trout, which is salable at a much higher price. Stock with fish nine to twelve months old, putting them into the pond either in autumn or spring at the rate of about 150 to 200 per hectare (60 to 80 per acre), and the product of a piece of water ought to be by this means considerably increased. But it will not be amiss to recall the fact that the rainbow trout is far from lending itself to manipulations which are necessary in fishing a pond with the same facility as the carp. When the carp has to be fished out and left for a few days in the fishing-place of the pond, which is always muddy at the moment of emptying, the trout, on the other hand, contracts almost always an inflammation of the gills which, if it does not cause immediate death, at least condemns the fish to lead henceforth a languishing and pining life.

In ponds where the water gets too warm in summer for the rainbow trout, one can employ perch to take the place of the pike. While the pike eats scarcely anything but fish, the perch, compelled by the small size of its mouth to come down to more modest prey, turns to account worms, insects and small crustaceans, which are disdained by the pike. The perch thus utilizes nutritive elements which would be lost with the pike. It also profits better from the food it consumes, and grows proportionally more than the pike, on an equal amount of food. According to the richness of the bottom and the resources in food supplied by the water, it is possible, in a pond devoted to carp, to raise also from 100 to 200 perch per hectare (40 to 80 per acre). A pond skirted by woods which supply it with a good many insects, or receiving waters charged with nutritive elements, may easily support 200 perch per hectare. But we may keep in view the fact that in some regions the perch is less salable than the pike at a remunerative price. The fish culturist should inform himself on this subject in the region where he is at work before deciding between the two species.—*Raveret-Wattel, in "L'Acclimatation" (Paris).*

THE ARTIFICIAL CULTURE AND HATCHING OF PIKE

I have read much about the artificial hatching of pike, but only in brief paragraphs, for the most part unintelligible to a layman. In the following statement I will endeavor to inform the laity about my experience in the hatching and rearing of pike; for with the steadily growing decrease of the pike and the even more rapid increase in price of the same, it will pay everyone where opportunity offers to multiply the pike as much as possible through artificial hatching and rearing.

First I will describe the artificial impregnation and incubation of the pike for such fishery owners or tenants as possess springs on their premises or any sort of water-course with a fall of at least one meter. The greater the fall the better fitted it is for the setting up of hatching jars—for the hatching in jars is the easiest and simplest.

For everyone who owns or leases a lake it is an easy thing to provide himself with good material in the shape of spawning pike. Suitable fishes for this purpose are females of 2 to 4 pounds, and males of any size. One must have plenty of males, for pike are poor milters and it takes five to ten males to fertilize the eggs of a two-pound pike, for the success of the work depends on ample fertilization. In the incubation of the eggs the main thing is that the water should have a temperature of 8° R. (50° F.).

Take a shallow plate or other dish, clean it carefully, put water into it, take a ripe roe-fish, which can be recognized in this way, that when it is grasped by the head, held up over the dish and stroked with the hand slowly downwards, the spawn runs out of itself. When the spawn is all out, take a milter that is ready at hand in a tub and proceed in the same way with him. With the milter one may give a severer pressure, for the milt does not run very readily from a pike.

When one has got enough milt he takes a feather and very gently stirs the spawn a few minutes, lets it stand a few minutes and then washes the eggs off, turns them with a little water into the plate, stirs them slowly about with the feather and then carefully pours the water off. This is repeated eight or ten times and then the eggs are turned into the hatching boxes standing ready: the best hatching boxes are of wood with wire-cloth inner apparatus. The water should fall into the box at one end with a drop of about a foot, in such a way that the eggs shall not be disturbed by the jet of water. At the other end of the box, the water runs off through some holes bored in the box, which must, however, be so located as to keep the eggs 1½-inch under water. After putting them into the boxes the eggs must be spread out evenly in the wire basket (or inner box) with a feather. One who has not fall enough to use hatching jars, must pick them after four or five days; for the bad eggs must be removed, else the good eggs will be infected by the bad ones and the whole thing become a mass of fungus. The picking can be done with a pair of long wooden pliers which one can make for himself.

It is certainly easier if one can use hatching jars, which can be bought of Koysi in Munich. If the eggs are to be hatched in jars, fit a faucet to a trough or long box. To the faucet attach a rubber hose of a length corresponding to the available fall. The other end of the hose is to be drawn on to a glass tube 40 or 50 centimeters (15 or 20 inches) long, taking care that the inner diameter of the hose is greater than that of the tube: the glass tube is pushed through a board with a hole of a size to secure a close fit. The board is laid across the jar. Let the water run till the jar is three-quarters full, then pour in the eggs out of the hatching box, let the jar run full and regulate the glass tube by pushing down or drawing up in the board so that the eggs will be continually in motion. Take care that all the eggs are in motion, and none of them get piled on the bottom at one side. Before the eggs are put into the jars, they should first stand three or four days in the hatching box.

After the eggs have been three or four days in the jar take away the board and the tube. When the eggs have settled down on the bottom of the jar it will be found that the good eggs have separated themselves from the bad, the fertilized eggs lying all underneath on the bottom and the bad eggs on top. Now turn the water slowly out of the jar, and the bad eggs will run out with the water. Should some of the bad eggs get mixed with the good ones, then let in the water again till the jar is half full and repeat the turning off.

Now insert the glass tube again in the jar and regulate it so that the eggs are all in motion. Should bad eggs again show themselves, repeat the operation. As soon as the eye-points appear, pour the eggs back into the hatching boxes. Should a few bad ones appear among them, they may be taken out with pliers. Commonly, after three or four days all the fish will be hatched. Let them stay in the boxes till they have lost the yolk-sac. Then take them out with a small gauze dipnet, put them in a pail of water and liberate them in the lake or pond in a sunny and quiet spot.

A man who has one or more ponds at his disposal grown with a good deal of grass and sedge, and stocked with not too small carp or other high-class fish, will do well to put the pike fry in them until autumn. For food give, if available, fish-spawn, which is just fine for small pike. In the fall they have commonly grown so that it takes five to ten for a pound, and they can then be released in the lake, or will find ready purchasers for stocking purposes.

One who has not the opportunity to set up hatching jars or boxes may proceed with the fertilization of pike-eggs in the way described above, and lay them out in the open lake, selecting the shallowest and best sheltered spots, if possible with a grassy bottom, or even on overflowed meadows, that will stand three or four weeks under water. Before all, care must be taken in laying out the spawn, that it is well spread out, so that the eggs shall touch each other as little as possible; for if a bad egg comes in contact with a good one, the good one is spoiled.—*Albert Michaelis, in "Fischerei-Zeitung" (Neudamm), December 18, 1909.*

EEL CULTURE IN GERMANY

The position held by eel culture in the estimation of the leading German authorities is perhaps best shown by the following extract from the annual report of the Central Fishery Society of Schleswig-Holstein for 1907-8:

"Of all measures that can be taken for the improvement of the fish of our waters and the increase of their product, the generous planting with eels appears to be the most important, especially for our numerous North German waters, A plentiful stocking of our waters, first of all the lakes, and then the flowing waters, with eels is really more important than many other fish distributions. The eel offers an excellent means of utilizing the nutritive material of our waters. Its principal foods (the larger insect-larvæ, bivalves and snails, water-fleas and bugs, ruffs and sticklebacks, and other small worthless fishes), everywhere to be found in considerable quantities, can hardly be utilized and turned into fish-flesh to the same extent by any other fish and certainly not by any so valuable fish as the eel. The eel always finds ready sale at very good prices. All organs upon which devolves the care of the German fisheries should therefore give the greatest attention to the multiplication of this fish in our waters. The stocking of our inland waters with eels depends at present on the ascent of eel-fry from the sea—from the North Sea and the Baltic.

"As is well known, eels do not breed in our inland waters, nor in the Baltic. Their spawning is done exclusively in the ocean where the depth exceeds 1000 meters (3280 ft.) and at places where, even at these great depths, a temperature not lower than 7° C. (44° F.) prevails. The spawning grounds of the eel that are of greatest importance to us lie off the west coast of the European Continent—off the British and French west coasts and the coast of northern Spain, at the point where the great plateau on which the North European continent stands, falls off sharply into the Atlantic basin and reaches depths exceeding 1000 meters. Especially important spawning grounds of the eel appear to lie southwesterly from Ireland and the mouth of the Bristol Channel. To these spawning grounds resort apparently all the eels grown in German waters and emigrating from the same every year, in anticipation of the ripening of their sexual products. From these remote spawning grounds, then, must the young fry retrace the whole long road back in order to enter our German waters. If, in spite of this immense distance, large numbers of eel-fry appear every year in the lower courses of our German rivers, the fact shows that the reproduction of the eel on its spawning grounds must be on an immense scale. Nevertheless if a slow but steady decrease in the catch of eels in our waters appears to have set in, it would indicate that there was a decrease in the immensity of the eel-fry immigration.

"In our waters themselves there existed increased difficulties for the ascent of the eel-fry, in this way, that the dams, which were formerly of inferior construction and gave the ascending eel-fry many an opportunity to slip through, have been so much improved by rebuilding that the surmounting of these dams is made completely impossible for eel-fry. We must confidently expect a decline more and more rapid of the product of our eel-fisheries unless measures are taken immediately for a plentiful stocking of our waters with eel-fry. This can be done and is done at many places in two ways; first by the construction of eel-ladders over the dams that are impassable for the fry, or by an intensive stocking with young eels, supplying the waters thus in an artificial way with what can no longer get to them in a natural way. For this purpose we should use either fry or partially grown eels. The latter would seem to be the better, having already reached greater age and acquired greater resisting power, compared with the tender fry that must be exposed to heavy losses after their liberation. But to get the larger eels in sufficient numbers is very difficult, and for a really ample yearly stocking of all waters that must be considered it would be impossible; for it must be remembered that since the eel does not reproduce in our inland waters, a single stocking or an occasionally repeated stocking does not answer, but that the stocking must be repeated every year.

"For partially grown eels there are thus far but few sources available—only the water courses tributary to the North and Baltic Seas. The supply of fry assumes in anticipation a position of great importance so soon as the difficulties of transportation from England to the inland waters are remedied, and should receive increased attention. Hitherto the eel-fry used in stocking German waters have come exclusively from Italy—all from the lower Arno. They were furnished at prices that yielded a handsome profit to the contractors, to be sure, but for persistent and effectual stocking of great lakes on a large scale they were too dear. This spring, by direction of the German Fishery Union, experiments have been made in the importation of eel-fry from England. Although these first transfers had to labor under many unexpected difficulties, yet the kernel of the project is sound, and the importation should later, with the great care and exertion thus far applied, develop more favorable conditions."

The appendix to the above report contains a detailed account of the conduct of several trips to England on account of the eel-fry importation between August, 1907, and May, 1908. Three importations of the fry were made in the spring of the year 1908, yielding a total of 1,670,000 eel-fry landed alive in Germany at Cuxhaven. These were distributed widely in interior waters. The work was continued in 1909 and 1910. In the latter year a total of 3,250,000 eel-fry were brought over in excellent condition from England to Hamburg.

In 1909 there were established by the German Fishery Societies numerous stations along the coast for observations on eels, especially as to their upward migration. The observers were fitted out with nets of special construction, with thermometers for water temperature and with material for preservation of specimens. Such fry as were captured were utilized by conveying them to inland waters.

Several books have been published in German devoted exclusively to the eel. The latest of these is the "Fluss-aal" (river-eel) by Dr. Emil Walter, issued in 1910, an octavo volume of 365 pages with 122 illustrations.

THE HORNED POUT OR BULLHEAD IN FRANCE

The question of catfish is always a present one, and the controversy over this species is always alive.

Monsieur Kuenstler, Professor of Sciences at Bordeaux, has lately made a new contribution to the discussion. Will it be final? Hardly probable, but it is of importance, as one may judge from the following extracts:

"A zealous press, not well informed, devotes enthusiastic articles to the American *Silurus.* Leaving the journals alone with their ardent descriptions, we have made some observations to inform ourselves about the habits, qualities and defects of the *Ameiurus.*

"In an aquarium he is difficult to keep a long time with other fishes, which he quickly destroys, if he finds hiding places during the day. He hunts all night and is one of the most dangerous enemies of fry, which he snaps up while they sleep. We have seen him practice his voracity on Salmonoid fry, gobbling them up whole or tearing off their fins and tails. For want of other fry he eats his own kind.

We have also seen small ones attack carp of larger size than themselves, fiercely entering the mouths and holding on by seizing the tongue or the side of the mouth, in which they bury the spines of their pectorals, thus causing local sores slow to heal. Whatever the species with which they are placed, the catfish quickly depopulate the basin. Their exclusively animal diet places them under an unavoidable necessity.

"One may judge from the result of one of the experiments tried in a pond in the public garden of Bordeaux, where they generally cultivate carp, roach, perch, etc., of which the fry are sent each spring to the Garonne. In 1907 with the mature breeders of the usual species there were introduced twelve hundred catfish one year old. The fishing at the beginning of May, 1908, was disconcerting. Where they had been accustomed to find swarms of small fish, not a single one could be found. The disaster corresponding with the introduction of the *Ameiurus,* it can hardly be doubtful (see also the results of other similar researches) that the responsibility lies in that direction.

"In a word it is the conclusion from all the observations that the catfish is dreadfully carnivorous. The most cursory examination of the contents of his intestine proves that. Motionless and hidden during the day, it surprises its victims during the night. A speedy depopulation of the waters is the result of its dissemination, which is a veritable public calamity. There is, happily, a corrective of the disastrous effects of the activities of ill-inspired zealots: the catfish generally disappears without appreciable cause, by pure and simple extinction: more than that, its voracity makes it the predestined prey of line-fishermen."

This arraignment by Professor Kuenstler is severe. Without doubt it will dispel some of their illusions for the champions of the catfish—for those at least who are not prejudiced in the matter.—*From "Bulletin Populaire de la Pisciculture" (Paris), May, 1909.*

A FISHERMAN'S SCHOOL IN BAVARIA

A Bavarian Fisherman's School is to be established in Starnberg by the Landesfischereiverein (Rural Fishery Union) with the support of Privy Counsellor Uhles. The school is to afford young people over 16 years of age opportunity to get a thorough education, theoretical and practical, in the callings of fisherman and fishery-manager, to which end the vicinity of Starnberg affords demonstration-objects in abundance. The first course is held from January 7th to February 19th. The tuition is free, and to citizens of Bavaria aid up to 60 marks is granted. On completion of the course the pupils receive certificates. The direction of the school is assigned to Dr. Walter Hein, scientific associate of the Royal Biological Experiment Station at Munich, to whom inquiries and announcements are to be addressed.

These fishermen's schools, as established in Friedrichshagen and Munich, supply a long felt need. They are the first step in a path that will, it is to be hoped, lead to permanent arrangements of this sort and have a favorable influence on the development of our professional fishermen. Privy Counsellor Uhles, who is to be thanked for this arrangement, has thereby given a new proof of his active interest in our fishing class.—*From "Fischerei-Zeitung" (Neudamm), November 13, 1909.*

DISCUSSION

Mr. Titcomb: Mr. Atkins is chairman of the committee and has done a large amount of faithful work in reading and translating foreign articles and getting them into shape for use. I have a rather lengthy report from him, which, owing to the large number of papers on the program, I am not going to read. But each one interested will want to read it and think over it. It treats of intensive pond culture, manuring of ponds to produce food, and treatment of ponds in general in producing food for fishes. That is an important feature. It treats also of eel culture, pike propagation, and other subjects in fish culture.

In this connection, if I may be permitted to do so, I will call your attention to a subject which was assigned to me for a paper, on the matter of the scientific feeding of fish. I was obliged to decline to prepare a paper at this time, because I did not have opportunity to do it, but the subject assigned me is one in which I am very much interested, though on which I am very ignorant. I wish to say, however, in connection with this report of the Committee on Foreign Relations, that the European countries seem to be far ahead of us in the production of fish food, in natural or artificial ponds, and that we are very ignorant on the subject of the scientific feeding of fish or the feeding of fish with artificial food. We do not know how much nourishment the fish get from the various kinds of food with which we supply them, especially the trout. The agriculturalists of this country today know more about feeding their cows; the scientific farmer knows where he gets the most milk and what it costs to feed, and all that sort of thing, a great deal more than we do about feeding fish. I merely bring this up in connection with this report, because I hope it is a subject which will interest more fish culturists as well as the scientists.

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'06 Thomas, W. H., U. S. Bureau of Fisheries, Homer, Minn.

'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, Fairport, Iowa.

'08 Thomson, G. H., Estes Park, Colo.

'10 Tierney, Jas. T., Roxbury, Vt.

'92 Titcomb, John W., Commission of Fisheries and Game, Lyndonville, Vt.

'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.

'09 Van Atta, Clyde H., U. S. Bureau of Fisheries, Leadville, Colo.

'02 Van Dusen, H. G., Astoria, Ore.

'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.

'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.

'08 Wallace, John H., Jr., Commissioner Department of Game and Fish, Montgomery, Ala.

'03 Wallich, Claudius, U. S. Bureau of Fisheries, Washington, D. C.

'96 Walters, C. H., Cold Spring Harbor, N. Y.

'98 Ward, Prof. H. B., University of Illionis, 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., Secretary Forest, Fish and Game Commission, 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.

'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.

'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.

'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.

'04 ZACHARIE, COL. F. C., 345 Corondelet St., New Orleans, La.

'99 ZALSMAN, P. G., Wisconsin Fish Commission, Wild Rose, Wis.

'92 ZWEIGHAFT, S., 239 S. Melville St., Philadelphia, Pa.

RECAPITULATION

HONORARY	74
CORRESPONDING	20
ACTIVE (including life members)	520
TOTAL MEMBERSHIP	614

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. Standing committees.

5. Committees appointed by the president.
   a. Committee of five on nomination of officers for ensuing year.
   b. Committee of three on time and place of next meeting.
   c. Auditing committee of three.
6. Reading of papers and discussion of same.
   (Note—a. In the reading of papers preference shall be given to the members present.
   b. The president and two secretaries are empowered to arrange the papers of the meetings of this Society.)
7. Miscellaneous business.
8. Adjournment.

ARTICLE VI

CHANGING THE CONSTITUTION

The constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting, provided at least fifteen members are present at said regular meeting.