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U. S. Bureau of Commercial Fisheries

OF THE

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UNITED STATES FISH COMMISSION.

VOL. III,

FOR

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JOINT RESOLUTION *authorizing the Public Printer to print reports of the United States Fish Commissioner upon new discoveries in regard to fish-culture.*

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Public Printer be, and he hereby is, instructed to print and stereotype, from time to time, any matter furnished him by the United States Commissioner of Fish and Fisheries relative to new observations, discoveries, and applications connected with fish-culture and the fisheries, to be capable of being distributed in parts, and the whole to form an annual volume or bulletin not exceeding five hundred pages. The extra edition of said work shall consist of five thousand copies, of which two thousand five hundred shall be for the use of the House of Representatives, one thousand for the use of the Senate, and one thousand five hundred for the use of the Commissioner of Fish and Fisheries.

ADVERTISEMENT.

UNITED STATES COMMISSION OF FISH AND FISHERIES,
Washington, D. C.

For the purpose of utilizing and of promptly publishing the large amount of interesting correspondence of the Fish Commission in reference to matters pertaining to fish-culture and to the apparatus, methods, and results of the fisheries, Congress, on the 14th day of February, 1881, by joint resolution (H. Res. 372), authorized the publication annually of a Bulletin, a portion of the edition to be distributed signature by signature, and the remainder in bound volumes. The present volume is the second of this series, and contains many announcements which are believed to be of great importance in relation to the subject in question.

CHAS. W. SMILEY., A. M., is the *Editor* of this volume.

SPENCER F. BAIRD,
Commissioner.

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BULLETIN

OF THE

UNITED STATES FISH COMMISSION.

1883.

1.—LIST OF PAPERS RELATING TO THE WORK OF THE UNITED STATES FISH COMMISSION FROM ITS ORGANIZATION IN 1871 TO JULY 1, 1883, AND WHICH HAVE BEEN PUBLISHED UNDER THE DIRECTION OF THE UNITED STATES FISH COMMISSION, THE NATIONAL MUSEUM, AND THE TENTH CENSUS, TOGETHER WITH A TOPICAL SYNOPSIS OF THE TITLES.

By CHAS. W. SMILEY.

[Prepared by request of Prof. S. F. Baird for the London Exhibition, 1883.]

This list was designed primarily for office reference and to prevent the accidental republication of papers. But in order to show the extent of the work done in this field, it has been elaborated for the purpose already indicated. It is believed to contain titles of all the separate articles, pamphlets, and important circulars which have been published with the approval of the Commissioner.

Very many papers which regularly appeared in the reports, bulletins, or proceedings also appeared as separate tracts, and all in the two last-named publications have been available in signature. In many cases the fact of separate publication will be noted.

LIST OF THE PUBLICATIONS CITED.

Report of the Commissioner for 1871–'72. pp. 900.
Report of the Commissioner for 1872–'73. pp. 910.
Report of the Commissioner for 1873–'74 and 1874–'75. pp. 830.
Report of the Commissioner for 1875–'76. pp. 1080.
Report of the Commissioner for 1876–'77. pp. 1042.
Report of the Commissioner for 1878. pp. 1052.
Report of the Commissioner for 1879. pp. 898.
Report of the Commissioner for 1880. pp 1108.
Bulletin of the U. S. Fish Commission, 1881. pp. 474.
Bulletin of the U. S. Fish Commission, 1882. pp. 475.
Proceedings of the National Museum, 1878. pp. 524. S. I. pub. No. 332.

Proceedings of the National Museum, 1879. pp. 503. S. I. pub. No. 333.
Proceedings of the National Museum, 1880. pp. 595. S. I. pub. No. 425.
Proceedings of the National Museum, 1881. pp. 678. S. I. pub. No. 467.
Proceedings of the National Museum, 1882. In press.
Bulletin of the National Museum, No. 5, 1876. pp. 84. S. I. No. 296.
Bulletin of the National Museum, No. 6, 1876. pp. 140. S. I. No. 297.
Bulletin of the National Museum, No. 9, 1877. pp. 56. S. I. No. 305.
Bulletin of the National Museum, No. 10, 1877. pp. 124. S. I. No. 306.
Bulletin of the National Museum, No. 11, 1882. pp. 64. S. I. No. 463.
Bulletin of the National Museum, No. 12, 1878. pp. 237. S. I. No. 308.
Bulletin of the National Museum, No. 14, 1879. pp. 351. S. I. No. 326.
Bulletin of the National Museum, No. 16, 1883. pp. 1018.
Bulletin of the National Museum, No. 18, 1880. pp. 263. S. I. No. 413.
Census Bulletin, No. 176, 1881. pp. 6.
Census Bulletin, No. 261, 1881. pp. 8.
Census Bulletin, No. 278, 1881. pp. 47.
Census Bulletin, No. 281, 1881. pp. 8.
Census Bulletin, No. 291, 1882. pp. 7.
Census Bulletin, No. 295, 1882. pp. 35.
Census Bulletin, No. 297, 1882. pp. 14.
Census Bulletin, No. 298, 1882. pp. 18.
Census Bulletin, special, 1881. pp. 251.
Census Bulletin, special, 1882. pp. 176.
Questions of the Census relating to Fish Trade and Consumption, 1879. pp. 3.
Specifications for two Steamers, 1879 and 1881. pp. 97.
Five series of Questions upon Cod, Mackerel, Smelt, Alewife, &c. 1876 (?). pp. 20.
Hints for Emergencies. By Dr. J. H. Kidder. 1877 (?). pp. 7.
Directions for Collecting and Preserving Fish. 1881. pp. 6. S. I. pub. No. 464.
Circular in Reference to Shipping fresh Fish and other Animals. 1881. pp. 4. S. I. No. 384.
Directory of Employés of the Smithsonian Institution, Fish Commission, &c. 1882. pp. 8. S. I. pub. No. 466.
Memoranda for the Construction of a Harbor of Refuge at Wood's Holl, Mass. 1882. pp. 6.
Laws and Regulations of the U. S. Fish Commission. 1882. pp. 32.
Classification of Exhibits at the London Exhibition. 1882. pp. 4.

An account of the work of the Fish Commission has been published annually since 1872 in the Report of the Smithsonian Institution, but as it was not in papers separate from other matter, this is the only reference to be made to the fact.

The Fish Commission was also interested in the preparation of the material for the American case as recorded in "Award of the Fishery

Commission. Documents and Proceedings of the Halifax Commission, 1877, under the Treaty of Washington of May 8, 1871. In three volumes. Washington: Government Printing Office. 1878." (Forty fifth Congress, second session, House of Representatives, Ex. Doc. No. 89.) pp. 1090, 1237, 1168.

The arrangement being by authors, it has been deemed best in the case of translations to insert the paper twice, once under the author's name and once under the translator's name.

A topical synopsis of the papers will be found at the close of the list.

I.—ARTICLES BY KNOWN AUTHORS ALPHABETICALLY ARRANGED.

1. **Abbott, Chas. C.** Notes on some fishes of the Delaware River.
   [In REPORT of the Commissioner for 1875–'76, Part IV, 1878, pp. 525–845.]
2. **Adams, A. Leith.** The lake trouts.
   [In REPORT of the Commissioner for 1872–'73, Part II, 1874, pp. 357–362.]
3. **Akekio, Sekizawa.** Memorandum on fish-culture in Japan, with a notice of experiments in breeding the California trout.
   [In REPORT of the Commissioner for 1879, Part VII, 1882, pp. 645–648.]
4. **Albro, Samuel.** Condition of the shore fisheries of Massachusetts and Rhode Island in 1871.
   [In REPORT of the Commissioner for 1871–'72, Part I, 1873, p. 8.]
5. **Allen, William S.** Statement concerning the menhaden fishery.
   [In REPORT of the Commissioner for 1877, Part V, 1879, pp. 413–414.]
6. **Allport, Morton.** Present state of the salmon experiment in Tasmania.
   [In REPORT of the Commissioner for 1878, Part VI, 1880, pp. 819–823.]
7. **Ameln, Johan.** Society for promoting the Norwegian fisheries.
   [In REPORT of the Commissioner for 1878, Part VI, 1880, pp. 241–243.]
8. **Anderson, G. A.** Report on shad-hatching in New Jersey in 1874.
   [In REPORT of the Commissioner for 1873–'74 and 1874–'75, Part III, 1876, pp. 327–328.]
9. **Anderson, R. B.,** TRANSLATOR. Report on the Norwegian deep-sea expedition of 1878. By G. O. Sars.
   [In REPORT of the Commissioner for 1878, Part VI, 1880, pp. 257–281.]
10. **Anderssen, Joakim.** Report on the department of fisheries in the world's exposition in Philadelphia, 1876.
    [In REPORT of the Commissioner for 1878, Part VI, 1880, pp. 47–71.]
11. **Anderton, J. L.** Statement concerning the menhaden fishery.
    [In REPORT of the Commissioner for 1877, Part V, 1879, pp. 460–461.]

12. **Armistead, A. Wilson.** A transfer of leather carp (*Cyprinus carpio*) from the Government ponds at Washington, U. S. A., to Scotland.

[In BULLETIN of the U. S. Fish Commission, Vol. I, 1881, pp. 341–342.]

13. **Arnold, jr., Isaac.** Successful propagation of black bass.

[In BULLETIN of the U. S. Fish Commission, Vol. II, 1882, pp. 113–115.]

14. **Atkins, Charles G.** On the salmon of Eastern North America, and its artificial culture.

[In REPORT of the Commissioner for 1872–'73, Part II, 1874, pp. 226–335.]

15. ————. On fish-ways.

[In REPORT of the Commissioner for 1872–'73, Part II, 1874, pp. 591–616.]

16. ————. Report on the collection and distribution of Penobscot salmon in 1873–'74 and 1874–'75.

[In REPORT of the Commissioner for 1873–'74 and 1874–'75, Part III, 1876, pp. 485–530.]

17. ————. On the collection of eggs of Schoodic salmon in 1875 and 1876.

[In REPORT of the Commissioner for 1875–'76, Part IV, 1878, pp. 910–919.]

18. ————. Report on the collection and distribution of Schoodic salmon eggs in 1877–'78.

[In REPORT of the Commissioner for 1877, Part V, 1879, pp. 817–846.]

19. ————. Report on an attempt to collect eggs of Sebago salmon in 1878.

[In REPORT of the Commissioner for 1878, Part VI, 1880, pp. 775–787.]

20. ————. Report on the collection and distribution of Schoodic salmon eggs in 1878–'79.

[In REPORT of the Commissioner for 1878, Part VI, 1880, pp. 789–814.]

21. ————. Cheap fixtures for the hatching of salmon.

[In REPORT of the Commissioner for 1878, Part VI, 1880, pp. 944–965; also separately.]

22. ————. Report on the propagation of Schoodic salmon in 1879–'80.

[In REPORT of the Commissioner for 1879, Part VII, 1882, pp. 733–766.]

23. ————. Report on the propagation of Penobscot salmon in 1879–'80.

[In REPORT of the Commissioner for 1879, Part VII, 1882, pp. 721–731.]

24. ————. Sketch of the Schoodic salmon-breeding establishment.

[In BULLETIN of the U. S. Fish Commission, Vol. II, 1882, pp. 379–382.]

25. ————. Sketch of the Penobscot salmon-breeding establishment.

[In BULLETIN of the U. S. Fish Commission, Vol. II, 1882, pp. 373–378.]

26. **Atkins, Charles G.** Report on the propagation of Schoodic salmon in 1880–'81.

[In REPORT of the Commissioner for 1880, Part VIII, 1883, pp. 623–631.]

27. ————. Report on the propagation of Penobscot salmon in 1880–'81.

[In REPORT of the Commissioner for 1880, Part VIII, 1883, pp. 633–651.]
(See also under Stilwell and Atkins.)

28. **Arthur, W.** Shipment of white fish eggs to New Zealand in 1878.

[In REPORT of the Commissioner for 1878, Part VI, 1880, pp. 857, 859, 864, 879.]

29. **Atwater, W. O.** Menhaden and other fish and their products as related to agriculture.

[In REPORT of the Commissioner for 1877, Part V, 1879, pp. 194–267.]

30. ————. Report of progress of an investigation of the chemical composition and economic values of the fish and invertebrates used for food. Undertaken for the United States Fish Commission.

[In REPORT of the Commissioner for 1880, Part VIII, 1883, pp. 231–283.]

31. **Atwood, Nathaniel E.** Fisheries on the coast of Massachusetts.

[In REPORT of the Commissioner for 1871–'72, Part I, 1873, pp. 117–124.]

32. ————. Abstract of an address in opposition to legislation concerning traps and pounds.

[In REPORT of the Commissioner for 1871–'72, Part I, 1873, pp. 223–227.]

33. **Atwood, William.** Statement concerning the menhaden fishery.

[In REPORT of the Commissioner for 1877, Part V, 1879, p. 404.]

34. **Babson, F. J.** Statement concerning the menhaden fishery.

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989. **Whaley, Joseph.** Statement concerning the menhaden fishery.
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1005. **Wilson, Edmund B.** Report on the *Pycnogonida* of New England and adjacent waters.

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1027. **Zentz, F.** On the races or varieties of carp, denying the existence of blue carp and gold carp.

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1046. Magdeburgische Zeitung. Stocking the Stettiner Haff with carp.

[In BULLETIN of the U. S. Fish Commission, Vol. II, 1882, pp. 1–8.]

1047. Nederlandsche Dierkundige Vereeniging, &c. Result of the investigations of the Netherlands Zoological station relative to the oyster and its cultivation at the end of the first year of its investigations.

[In REPORT of the Commissioner for 1880, Part VIII, 1883, pp. 1001–1027.]

1048. Nordisk Tidsskrift for Fiskeri. The fishing villages, Snekkersteen and Skotterup, and the collection of fishing-implements exhibited by them at Elsinore, Denmark, during the summer of 1872.

[In REPORT of the Commissioner for 1873–'74 and 1874–'75, Part III, 1876, pp. 173–181.]

1049. ————. New contributions to the herring question. The dispute between Axel Boeck and Ossian Sars, regarding the Norwegian summer-herring. Sars's recent observations, and his new theory on the migrations of the herring.

[In REPORT of the Commissioner for 1873–'74 and 1874–'75, Part III, 1876, pp. 195–211.]

1050. ————. On the artificial propagation of the lobster.

[In REPORT of the Commissioner for 1873–'74 and 1874–'75, Part III, 1876, pp. 267–269.]

1051. **Nordisk Tidsskrift for Fiskeri.** On ponds for the culture of the carp.

[In REPORT of the Commissioner for 1873–'74 and 1874–'75, Part III, 1876, pp. 549–552.]

1052. **Norwegian Commission.** On the fisheries of Norway.

[In REPORT of the Commissioner for 1873–'74 and 1874–'75, Part III, 1876, pp. 25–30.]

1053. **Oesterreichisch-Ungarische Fischerei-Zeitung.** Peat-bogs as fish-ponds.

[In BULLETIN of the U. S. Fish Commission, Vol. I, 1881, pp. 58–59.]

1054. **Scientific Farmer.** Connection of abundance of moss and of black flies with abundance of trout.

[In BULLETIN of the U. S. Fish Commission, Vol. II, 1882, pp, 103–104.]

1055. **Sunland Tribune.** Poisoned water in the Gulf of Mexico.

[In BULLETIN of the U. S. Fish Commission, Vol. II, 1882, p. 104.]

1056. **Swedish Fishery Report.** Improvement in the salmon fisheries of Sweden.

[In REPORT of the Commissioner for 1872–'73, Part II, pp. 1874, 166–167.]

1057. **Weser-Zeitung.** Living shad on their way to the Weser.

[In REPORT of the Commissioner for 1873–'74 and 1874–'75, Part III, 1876, pp. 330–335.]

1058. **Bean, Tarleton H.*** Description of a new species of *Alepidosaurus* (*A. Æsculapius*), from Alaska.

[In PROCEEDINGS of the U. S. Nat. Mus., Vol. V, 1882, pp. 661–663.]

III.—ARTICLES IN TYPE FOR REPORT OF THE COMMISSIONER FOR 1881, PART IX.

1059. **Atkins, Chas. G.** Report on the propagation of Penobscot salmon in 1881–'82.

1060. ——————. Report on the propagation of Schoodic salmon in 1881–'82.

1061. **Bouchon-Brandely, M.** Report to the Minister of the Marine relative to oyster culture upon the shores of the British Channel and the ocean.

1062. **Brocchi, Dr. P.** Report on the present condition of oyster culture in France.

1063. **Bean, Tarleton, H.** TRANSLATOR. The Loffoden fishery in 1880. By Lieut. Niels Juel.

1064. **Clark, Frank N.** Report of work at the United States Hatchery, Northville, Mich., 1881–'82.

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* This item was omitted from its proper place by mistake.—EDITOR.

1065. **Dyrenforth, Robert G.** List of patents issued in the United States during the year 1881 relating to fish, and the methods, products, and applications of the fisheries.

1066. **Forbes, S. A.** The first food of the common white-fish (*Coregonus clupeiformis*, Mitch.).

1067. **Goode, G. Brown, Joseph W. Collins, R. E. Earll, and A. Howard Clark.** Materials for a History of the Mackerel Fishery.

1068. **Juel, Niels.** The Loffodon fishery in 1880.

1069. **McDonald, Marshall.** TRANSLATOR. Report of the Minister of the Marine relative to oyster culture upon the shores of the British Channel and the ocean. By M. Bouchon-Brandely.

1070. **Smiley, Chas. W.** The extent of the use of fish guano as a fertilizer.

1071. ————. Statistics of the shad hatching operations conducted by the United States Fish Commission in 1881.

1072. **Snell, Merwin P.** TRANSLATOR. Report on the present condition of oyster culture in France. By Dr. P. Brocchi.

1073. **Stone, Livingston.** Report of operations at the United States salmon-breeding station on the McCloud River, California, during the season of 1881.

1074. ————. Report of operations at the United States trout ponds, McCloud River, California, for the season of 1881.

1075. **Tanner, Z. L.** Report on construction, equipment, and cruise of the United States Fish Commission steamer Fish Hawk during the fall of 1879 and year of 1880.

1076. ————. Report of the work of the United States Fish Commission steamer Fish Hawk for the year ending December 31, 1881.

1077. **Webster, H. E., and James E. Benedict.** The *Annelida chætopoda* from Provincetown and Wellfleet, Mass.

Of the foregoing 1,077 titles, 102 are under translators' names, and 7 are references to co-editors or duplicates, so that the actual number of separate papers enumerated is 968.

NOTE.—The following additions should be made to the citations in this list:

Page 4, No. 14, 10 pl. and folding map; page 4, No. 15, 15 pl.; page 4, No. 18, 1 pl.; page 4, No. 21, 15 figs.; page 5, No. 30, with index; page 6, No. 46, 3 pl., 19 figs.

Vol. III, No. 6. Washington, D. C. Aug. 9, 1883.

TOPICAL SYNOPSIS OF THE TITLES CONTAINED IN THE FOREGOING BIBLIOGRAPHY.

[NOTE.—The references are to the numbers attached to each paper.]

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2.—A LIST OF THE PUBLISHED REPORTS OF THE COMMISSIONERS APPOINTED BY AUTHORITY OF THE VARIOUS STATES OF THE UNITED STATES.

By CHAS. W. SMILEY.

[Prepared by request of Prof. S. F. Baird, for the London Exhibition, 1883.]

The library of the United States Fish Commission contains a very complete set of the reports that have been made by the commissioners of the various States to their legislatures. They perhaps constitute, next to the publications of the United States Fish Commission, the most valuable contribution to the history of pisciculture in this country.

This list is arranged chronologically, or as nearly so as possible. In many cases, however, no exact date was given to the publications. This bibliography is believed to be complete from 1857 to 1883. In addition to the numbers to denote chronological sequence, a number has been placed in brackets after the name of each State to denote the sequence of the State reports.

This chronological list will be followed by a check-list arranged by States.

1857.

1. **Massachusetts.** [1.] (May 5, 1857.)—Report of Commissioners appointed under resolve of 1856, chap. 58, concerning the Artificial Propagation of Fish, with other documents. Boston: William White, Printer to the State. 1857. 8vo, pp. 54.
2. **Vermont.** [1.] (Oct. 22, 1857.)—Report made under authority of the Legislature of Vermont on the Artificial Propagation of Fish, by George P. Marsh. Burlington: Free Press Print. 1857. 8vo, pp. 62.

1865.

3. **New Hampshire.** [1.] (July 1, 1865.)—Report of the Select Committee on Fisheries. June session, 1865. Concord: George E. Jenks, State printer. 1865. 8vo, pp. 8.
4. **Massachusetts.** [2.] (Dec. 1, 1865.)—Report of the Commissioners appointed under the resolve of May 3, 1865, "Concerning the obstructions to the passage of fish in the Connecticut and Merrimac Rivers." 8vo, pp. 77, pl. 2.

1866.

5. **New Hampshire.** [2.] (June 1, 1866.)—Report of the Commissioners of Fisheries, made to the Legislature of New Hampshire, June session, 1866. Concord: George E. Jenks, State printer. 1866. 8vo, pp. 16.

6. **Vermont.** [2.] (Oct. 11, 1866.)—Report of Commissioners relative to the Restoration of Sea-Fish to the Connecticut River and sit tributaries. By order of the Legislature of Vermont. Annual session, 1866. Montpelier: Freeman Steam Printing Establishment. 1866. 8vo, pp. 35, 1 cut.

1867.

7. **Connecticut.** [1.] (May, 1867.)—Report of the Commissioners concerning the protection of fish in the Connecticut River, &c., to the general assembly, May session, 1867. Printed by order of the legislature. Hartford: Case, Lockwood & Co., printers. 1867. 8vo, pp. 25, pl. 1.
8. **New Hampshire.** [3.] (July 5, 1867.)—Report of the Commissioners on Fisheries of the State of New Hampshire, June session, 1867. (A written copy of the report.)
9. **Vermont.** [3.] (Oct. 25, 1867.)—Report of the Fish Commissioners of the State of Vermont, by Albert D. Hager and Charles Barrett, for the year 1867. Montpelier: Walton's Steam Printing Establishment. 1867. 8vo, pp. 25. (There was no report in 1868.)

1868.

10. **Maine.** [1.] (Jan. 16, 1868.)—Reports of the Commissioners of Fisheries of the State of Maine, for the years 1867 and 1868. Augusta: Owen & Nash, printers to the State. 1869.
First report—1867. 8vo, pp. 96, pl. 2. (River Fish-Weirs and Fishway.)
11. **Massachusetts.** [3.] (Jan., 1868.)—Report of the Commissioners of Fisheries, for the year ending January 1, 1868. Boston: Wright & Potter, State printers, No. 4 Spring Lane. 1868. 8vo, pp. 50, pl. 3.
12. **Connecticut.** [2.] (May, 1868.)—Report of the Commissioners on Fisheries to the general assembly, May session, 1868. New Haven: Thomas J. Stafford, State printer. 1868. 8vo, pp. 28.
13. **New Hampshire.** [4.] (June 18, 1868.)—Report of the Commissioners on Inland or River Fisheries, June session, 1868. Manchester: John B. Clarke, State printer. 8vo, pp. 8.
14. **Maine.** [2.] (Dec. 31, 1868.)—Reports of the Commissioners of Fisheries of the State of Maine, for the years 1867 and 1868. Augusta: Owen & Nash, printers to the State. 1869.
Second report—1868. 8vo, pp. 45. 1 pl. of *Grystes fasciatus*.

1869.

15. **Massachusetts.** [4.] (Jan., 1869.)—Report of the Commissioner of Fisheries, for the year ending January 1, 1869. Boston: Wright & Potter, State printers, No. 79 Milk street (corner of Federal street). 1869. 8vo, pp. 71.

16. **Rhode Island.** [1.] (Feb. 15, 1869.)—Report of the Commissioners to investigate the practicability of restocking the waters of the State with salmon and other migratory fish. 8vo, pp. 9. Appendix, pp. 27. Containing an article from Harper's Magazine, with 26 cuts.

17. **New York.** [1.] (Mar. 9, 1869.)—Fisheries of the State of New York. Report of the Commissioners of Fisheries of the State of New York, giving the number, names, location, and areas of all the lakes within the State of New York, the coast lines of Lakes Ontario and Erie, and that portion of the State bordering on the ocean, with a map, showing the lakes, streams in the State, railroad and canal lines. Transmitted to the legislature March 9, 1869. Albany: Weed, Parsons & Co., printers and publishers. 1869. 8vo, pp. 75, 1 map.

18. **Connecticut.** [3.] (May, 1869.)—Report of the Commissioners of Fisheries to the general assembly, May session, 1869. Middletown: A. Newton & Son, printers. 1869. 8vo, pp. 18.

19. **New Hampshire.** [5.] (June 21, 1869.)—Report of the Fish Commissioners to the legislature, June session, 1869. Manchester: John B. Clarke, State printer. 1869. 8vo, pp. 10.

20. **Vermont.** [4.] (Oct. 25, 1869.)—Report of the Fish Commissioners of the State of Vermont, by Albert D. Hager and Charles Barrett, for the year 1869. Montpelier: Poland's Steam Printing Establishment, Journal Building, State street. 1869. 8vo, pp. 16. (There was no report in 1868.)

21. **Maryland.** [1.] (Oct., 1869.)—Report upon the Oyster Resources of Maryland to the general assembly, by Hunter Davidson, esq., Com. State Oyster Police Force. Annapolis: Wm. Thompson of R., printer. 1870. 8vo, pp. 20.

22. **South Carolina.** [1.] (Nov. 10, 1869.)—Proceedings of the Annual Convention of the South Carolina Agricultural and Mechanical Society, held in Columbia, S. C., Nov. 10–12, 1869. Charleston, S. C.: Walker, Evans & Coggswell, printers, Nos. 3 Broad and 109 East Bay street. 1869. 8vo., pp. 21–26 and 45–47.

23. **Maine.** [3.] (Dec. 31, 1869.)—Third Report of the Commissioner of Fisheries of the State of Maine, 1869. Augusta: Sprague, Owen & Nash, printers to the State. 1870. 8vo, pp. 48.

1870.

24. **Rhode Island.** [2.] (January, 1870.)—A—Majority report of the Committee on Fisheries, Jan. session, A. D. 1870. 8vo, pp. 6. B—Minority report of the Committee on Fisheries. January session, A. D. 1870. 8vo, pp. 3.

25 **Massachusetts.** [5.] (Jan., 1870.)—Report of the Commissioners of Fisheries, for the year ending January 1, 1870. Boston: Wright & Potter, State printers, 79 Milk street (corner of Federal). 1870. 8vo, pp. 67, pl. 1.

26. **New York.** [2.] (Mar. 11, 1870.)—Report of the Commissioners of Fisheries of the State of New York. Transmitted to the legislature March 11, 1870. Albany: The Argus Company, printers. 1870. 8vo, pp. 20.

27. **Connecticut.** [4.] (May 7, 1870.)—Fourth Report of the Commissioners of Fisheries of the State of Connecticut, 1870. Hartford: Case, Lockwood & Brainard, printers. 1870. 8vo, pp. 37.

28. **New Hampshire.** [6.] (June 10, 1870.)—Report of the Commissioners on Fisheries of the State of New Hampshire, June session, 1870. Manchester: John B. Clarke, State printer. 1870. 8vo, pp. 15.

29. **Rhode Island.** [3.] (June 15, 1870.)—Report of the joint special committee of the general assembly of Rhode Island, appointed to examine into the fisheries of Narragansett Bay, May session, A. D. 1870. Pawtucket: Nickerson & Sibley, book and job printers. 1870. 8vo, pp. 159.

30. **Alabama.** [1.] (Dec. 13, 1870.)—Report on Pisciculture and Memorial of the East Alabama Agricultural Society. John S. Logan, job printer, Opelika, Ala. 8vo, pp. 4.

31. **Maine.** [4.] (Dec. 31, 1870.)—Fourth Report of the Commissioner of Fisheries of the State of Maine, for the year 1870. Augusta: Sprague, Owen & Nash, printers to the State. 1870. 8vo, pp. 56, pl. 2.

32. **New Jersey.** [1.] (Dec., 1870?)—First Annual Report of the Commissioners of Fisheries of the State of New Jersey, 1871. Trenton, N. J.: Murphy & Bechtel, book and job printers, State Gazette office. 1871. 8vo, pp. 25, pl. 2, 1 map.

1871.

33. **Pennsylvania.** [1.] (Jan. 23, 1871.)—Commonwealth of Pennsylvania. Report of the Commissioner for the Restoration of the Inland Fisheries, for the year 1870. Harrisburg: B. Singerley, State printer. 1871. 8vo, pp. 48.

34. **Rhode Island.** [4.] (Jan. 25, 1871.)—Report of the Commissioners of Inland Fisheries. (Appendix [to] Public Document No. 5.) 8vo, pp. 4.

35. **Massachusetts.** [6.] (Jan., 1871.)—Fifth Annual Report of the Commissioners on Inland Fisheries, January, 1871. Boston: Wright & Potter, State printers, 79 Milk street (corner of Federal), 1871. 8vo, pp. 77.

36. **New York.** [3.] (Feb. 1, 1871.)—Report of the Commissioners of Fisheries of the State of New York. Transmitted to the legislature February 28, 1871. Albany: The Argus Company, printers. 1871. 8vo, pp. 32.

37. **Connecticut.** [5.] (May 12, 1871.)—Fifth Report of the Commissioners of Fisheries of the State of Connecticut, 1871. Hartford: Case, Lockwood & Brainard, printers. 1871. 8vo, pp. 46, pl. 2.

38. **New Hampshire.** [7.] (May 29, 1871.)—Report of the Commissioners on Fisheries of the State of New Hampshire, June session, 1871. Nashua: Orren C. Moore, State printer. 1871. 8vo, pp. 11.

39. **Virginia.** [1.] (Oct. 1, 1871.)—Report to the Auditor of Public Accounts on the Oyster Beds of Virginia, by Orris A. Browne, Inspector for third district of Virginia. Richmond: Shepperson & Graves, printers. 1872. 8vo, pp. 21, including appendices.

40. **Maine.** [5.] (Dec. 31, 1871.)—Fifth Report of the Commissioner of Fisheries of the State of Maine, for the year 1871. Augusta: Sprague, Owen & Nash, printers to the State. 1872. 8vo, pp. 31, pl. 1.

41. **California.** [1.] (Dec. 31, 1871?)—Report of the Commissioners of Fisheries of the State of California, for the years 1870 and 1871. 8vo, pp. 24.

42. **New Jersey.** [2.] (Dec., 1871?)—Second Annual Report of the Commissioners of Fisheries of the State of New Jersey. 1872. Trenton, N. J.: Printed at the Gazette office. 1872. 8vo, pp. 22.

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43. **Maryland.** [2.] (Jan. 1, 1872.)—Report on the Oyster Fisheries: Potomac River Shad and Herring Fisheries, and the Water Fowl of Maryland to his excellency the Governor and other Commissioners of the State O. P. Force, January, 1872. Annapolis: S. S. Mills, L. F. Colton & Co., printers. 1872. 8vo, pp. 48.

44. **Pennsylvania.** [2.] (Jan. 16, 1872.)—Commonwealth of Pennsylvania. Report of the Commissioner for the Restoration of the Inland Fisheries, for the year 1871; including his special report to the senate on the subject of fish ladders. Harrisburg: B. Singerley, State printer. 1872. 8vo, pp. 24, pl. 2.

45. **Alabama.** [2.] (Jan. 26, 1872.)—Report of the Commissioners to encourage Fish Culture, submitted to the Governor of Alabama, January 26, 1872. Senate, 1,000 copies. Montgomery, Ala.: W. W. Screws, State printer. 1872. 8vo, pp. 7.

46. **Massachusetts.** [7.] (Jan., 1872.)—Sixth Annual Report of the Commissioners on Inland Fisheries, for the year ending January 1, 1872. Boston: Wright & Potter, State printers, 79 Milk street (corner of Federal). 1872. 8vo, pp. 78, and Appendix, pp. 270, pl. 2.

47. Rhode Island. [5.] (Feb. 23, 1872.)—Report of the Commissioners of Internal Fisheries, presented February, 1872. Appointed by the governor in accordance with chap. 920, sec. 1, "An act in amendment of Chap. 848, of the public laws," entitled "An act for the encouraging and regulating inland fisheries," passed March 21, 1871. Providence: A. Crawford Greene, printer to the State. 1872. 8vo, pp. 16.

48. New York. [4.] (March 19, 1872?)—Fourth Annual Report of the Commissioner of Fisheries of the State of New York. Transmitted to the legislature March 19, 1872. Albany: The Argus Company, printers. 1872. 8vo, pp. 34.

49. Connecticut. [6.] (April 26, 1872.)—Sixth Report of the Commissioners of Fisheries of the State of Connecticut, 1872. Hartford: Press of Case, Lockwood & Brainard. 1872. 8vo, pp. 36.

50. New Hampshire. [8.] (May 27, 1872.)—Report of the Commissioners on Fisheries of the State of New Hampshire, June session, 1872. Manchester: James M. Campbell, State printer. 1872. 8vo, pp. 15.

51. Vermont. [5.] (Oct. 29, 1872.)—Report of the Fish Commissioners of the State of Vermont, by M. C. Edmunds and M. Goldsmith, for the years 1871–'72. Montpelier: J. & J. M. Poland's Steam Printing Establishment. 1872. 8vo, pp. 20. (No report in 1870.)

52. Maine. [6.] (Dec. 31, 1872?)—Sixth Report of the Commissioners of Fisheries of the State of Maine, for the year 1872. Augusta: Sprague, Owen & Nash, printers to the State. 1873. 8vo, pp. 16.

53. New Jersey. [3.] (Dec., 1872?)—Third Annual Report of the Commissioners of Fisheries of the State of New Jersey, for the year 1872. Trenton, N. J.: The State Gazette, Murphy & Bechtel, book and job printers. 1872. 8vo, pp. 28.

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54. Massachusetts. [8.] (Jan., 1873.)—Seventh Annual Report of the Commissioners on Inland Fisheries, for the year ending January 1, 1873. Boston: Wright & Potter, State printers, 19 Province street. 1873. 8vo., pp. 35, pl. 3.

55. New York. [5.] (Jan., 1873.)—Report of the Commissioners of Fisheries of the State of New York. Transmitted to the legislature February 12, 1873. Albany: The Argus Company, printers. 1873. 8vo, pp. 32.

56. Rhode Island. [6.] (Feb. 24, 1873.)—Third Annual Report of the Commissioners of Inland Fisheries, made to the general assembly at its January session, A. D. 1873. Providence: Providence Press Company, printers to the State. 1873. 8vo, pp. 10.

57. **Connecticut.** [7.] (May 1, 1873.)—Seventh Report of the Commissioners of Fisheries of the State of Connecticut, 1873. Hartford, Conn.: Press of Case, Lockwood & Brainard. 1873. 8vo, pp. 48.

58. **New Hampshire.** [9.] (May 30, 1873.)—Report of the Commissioners on Fisheries of the State of New Hampshire, June session, 1873. Nashua: Orren C. Moore, State printer. 1873. 8vo, pp. 13.

59. **Massachusetts.** [9.] (Dec. 1, 1873.)—Eighth Annual Report of the Commissioners on Inland Fisheries, for the year ending January 1, 1874. Boston: Wright & Potter, State printers, corner Milk and Federal streets. 1874. 8vo, pp. 63, pl. 1.

60. **Maine.** [7.] (Dec. 31, 1873.)—Seventh Report of the Commissioners of Fisheries of the State of Maine, for the year 1873. Augusta: Sprague, Owen & Nash, printers to the State. 1873. 8vo, pp. 39.

61. **California.** [2.] (Dec. 31, 1873?)—Report of the Commissioners of Fisheries of the State of California, for the years 1872 and 1873. 8vo, pp. 18.

62. **California.** [3.] (Dec. 31, 1873?)—Report of the Commissioners of Fisheries of the State of California, for the years 1872 and 1873. San Francisco: Francis & Valentine, printers and engravers, 517 Clay street. 1874. 8vo, pp. 28. (Reprint.)

63. **Pennsylvania.** [3.] (Dec. 31, 1873?)—Commonwealth of Pennsylvania. Report of the State Commissioners of Fisheries, for the year 1873. Harrisburg: Benjamin Singerley, State printer. 1874. 8vo, pp. 32, 1 map.

64. **New Jersey.** [4.] (Dec., 1873?)—Fourth Annual Report of the Commissioners of Fisheries of the State of New Jersey, for the year 1873. Trenton, N. J.: The State Gazette, Murphy & Bechtel, book and job printers. 1873. 8vo, pp. 32, pl. 1.

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65. **Maryland.** [3.] (Jan. 1, 1874.)—Report of the Commander of the Oyster Fisheries and Water Fowl of Maryland to his excellency the governor and the Commissioners of the State O. P. Force, January 1, 1874. Annapolis: William T. Iglehart & Co., printers to the State. 1874. 8vo, pp. 11.

66. **Utah.** [1.] (Jan. 1, 1874.)—Report of Deseret Agricultural and Manufacturing Society, for the years 1872–'73. David O. Calder, public printer, Salt Lake City, Utah. 8vo, pp. 5–7.

67. **New York.** [6.] (Jan., 1874.)—Report of the Commissioners of Fisheries of the State of New York. Transmitted to the legislature February 5, 1874. Albany: Weed, Parsons & Co., printers. 1874. 8vo, pp. 41, pl. 8, 1 cut.

68. **Rhode Island.** [7.] (Feb. 19, 1874.)—Fourth Annual Report of the Commissioners on Inland Fisheries, made to the general assembly at its January session, A. D. 1874. Providence: Providence Press Company, printers to the State. 1874. 8vo, pp. 10.

69. **Ohio.** [1.] (Feb. 23, 1874.)—Report of the Commissioners of Fisheries of the State of Ohio, for the year ending December, 1873. Columbus: Nevins & Myers, State printers. 1874. 8vo, pp. 40, 5 cuts. (*Grystes nigricans, G. megastoma, Labrax multilineatus, Centrarchus hexacanthus.*)

70. **Connecticut.** [8.] (April 30, 1874.)—Eighth Report of the Commissioners of Fisheries of the State of Connecticut, 1874. Hartford: Press of the Case, Lockwood & Brainard Company, 1874. 8vo, pp. 36.

71. **New Hampshire.** [10.] (May 20, 1874.)—Report of the Commissioners on Fisheries of the State of New Hampshire, June session, 1874. Concord: Edward A. Jenks, State printer. 1874. 8vo, pp. 15.

72. **Vermont.** [6.] (Oct. 27, 1874.)—Report of the Fish Commissioners of the State of Vermont, by M. C. Edmunds and M. Goldsmith, for the years 1873–'74. Rutland: Tuttle & Co., printers. 1874. 8vo, pp. 80, 2 cuts.

73. **New Jersey.** [5.] (Nov. 14, 1874?)—Fifth Annual Report of the Commissioners of Fisheries of the State of New Jersey, for the year 1874. Trenton, N. J.: Public Opinion—W. S. Sharp, book and job printer, 86 and 88 Warren street. 1874. 8vo, pp. 62.

74. **Maine.** [8.] (Nov. 30, 1874.)—Eighth Report of the Commissioners of Fisheries of the State of Maine, for the year 1874. Augusta: Sprague, Owen & Nash, printers to the State. 1874. 8vo, pp. 32.

75. **Massachusetts.** [10.] (Dec. 1, 1874.)—Ninth Annual Report of the Commissioners on Inland Fisheries, for the year ending January 1, 1875. Boston: Wright & Potter, State printers, 79 Milk street (corner of Federal). 1875. 8vo, pp. 57.

76. **Michigan.** [1.] (Dec. 1, 1874.)—First Report of the State Commissioners and Superintendent, on State Fisheries, for 1873–'74, ending December 1, 1874. By authority. Lansing: W. S. George & Co., State printers and binders. 1875. 8vo, pp. 67.

77. **Wisconsin.** [1.] (Dec., 1874.)—First Annual Report of the Fish Commissioners of the State of Wisconsin, to his excellency Governor William R. Taylor. Madison, Wis.: E. B. Bolens, State printer. 1875. 8vo, pp. 8.

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78. **Rhode Island.** [8.] (Jan. 30, 1875.)—Fifth Annual Report of the Commissioners on Inland Fisheries, made to the general assembly at its January session, A. D. 1875. Providence: Providence Press Company, printers to the State. 1875. 8vo, pp. 20.

79. **New York.** [7.] (Jan., 1875.)—Seventh Annual Report of the Commissioners of Fisheries of the State of New York. Transmitted to the legislature February 1, 1875. Albany: Weed, Parsons & Co., printers. 1875. 8vo, pp. 60, pl. 15, diag. 1.

80. **Minnesota.** [1.] (Feb. 20, 1875.)—First Annual Report of the State Fish Commissioners of Minnesota. Printed by order of the legislature. Saint Paul: 1875. 8vo, pp. 30.

81. **New Hampshire.** [11.] (Feb. 20, 1875.)—Report of the Commissioners on Fisheries of the State of New Hampshire. June session, 1875. Concord: Charles C. Pearson, State printer, 1875. 8vo, pp. 16.

82. **Connecticut.** [9.] (May 1, 1875.)—Ninth Report of the Commissioners on Fisheries of the State of Connecticut, 1875. Hartford: Press of the Case, Lockwood & Brainard Company. 1875. 8vo, pp. 32.

83. **Iowa.** [1.] (Oct. 27, 1875?)—First Report of the State Fish Commissioners of Iowa, for the years 1874 and 1875. Des Moines: R. P. Clarkson, State printer. 1876. 8vo, pp. 40.

84. **New Jersey.** [6.] (Nov. 14, 1875?)—Sixth Annual Report of the Commissioners of Fisheries of the State of New Jersey, for the year 1875. Trenton, N. J.: Public Opinion—William S. Sharp, steam power book and job printer. 1875. 8vo, pp. 35.

85. **Maine.** [9.] (Dec. 9, 1875?)—Ninth Report of the Commissioners of Fisheries of the State of Maine, for the year 1875. Augusta: Sprague, Owen & Nash, printers to the State, 1875. 8vo, pp. 40.

86. **Massachusetts.** [11.] (Dec. 15, 1875?)—Tenth Annual Report of the Commissioners on Inland Fisheries, for the year ending January 1, 1875. Boston: Wright & Potter, State printers, 79 Milk street (corner of Federal), 1876. 8vo, pp. 72.

87. **California.** [4.] (Dec. 31, 1875?)—Report of the Commissioners of Fisheries of the State of California, for the years 1874 and 1875. 8vo, pp. 36.

88. **Pennsylvania.** [4.] (Dec. 31, 1875?)—Commonwealth of Pennsylvania. Report of the State Commissioners of Fisheries, for the year 1874. Harrisburg: B. F. Meyers, State printer, 1875. 8vo, pp. 29.

89. Virginia. [2.] (Dec. 31, 1875?)—Annual Report of the Fish Commissioners of the State of Virginia, for the year 1875. Richmond: R. F. Walker, superintendent public printing, 1875. 8vo, pp. 34, 3 cuts. (Striped bass, brook trout, and black bass.)

90. Wisconsin. [2.] (Dec., 1875.)—Second Annual Report of the Commissioners of Fisheries of the State of Wisconsin. Madison, Wis.: E. B. Bolens, State printer, 1875. 8vo, pp. 15.

91. Minnesota. [2.] (Dec., 1875?)—Second Annual Report of the State Fish Commissioners of Minnesota. Saint Paul: Pioneer Press Company, 1876. 8vo, pp. 19.

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92. Maryland. [4.] (Jan. 1, 1876.)—Frontispiece. Report of the Commissioners of Fisheries of Maryland, January, 1876. Annapolis: John F. Wiley, printer. 1876. 8vo, pp. 176, lxiii. 1 map, pl. 6 (including frontispiece). Contains list of Maryland fishes, by P. R. Uhler and Otto Lugger.

93. Utah. [2.] (Feb. 14, 1876.)—Statistical Report of the Deseret Agricultural and Manufacturing Society, for the year 1875. Presented to the legislative assembly by Hon. A. P. Rockwood, February 14, 1876. David O. Calder, public printer. Salt Lake City: Printed at the Deseret News steam printing establishment. 1876. 8vo, pp. 8.

94. Rhode Island. [9.] (Feb. 29, 1876.)—State of Rhode Island and Providence Plantations. Annual Report of the Commissioners on Inland Fisheries, made to the general assembly of the State of Rhode Island at its January session, A. D. 1876. Providence: Providence Press Company, printers to the State. 1876. 8vo, pp. 11.

95. New York. [8.] (Feb., 1876.)—Eighth Annual Report of the Commissioners of Fisheries of the State of New York, for the year ending December 31, 1875. Transmitted to the legislature March 17, 1876. Jerome B. Parmenter, State printer, 1876. 8vo, pp. 59.

96. New Hampshire. [12.] (March 2, 1876.)—Report of the Commissioners on Fisheries of the State of New Hampshire, June session, 1876. Concord: Edward A. Jenks, State printer. 1876. 8vo, pp. 16.

97. Connecticut. [10.] (May 17, 1876.)—Tenth Report of the Commissioners on Fisheries of the State of Connecticut, 1876. Hartford: Press of the Case, Lockwood & Brainard Company. 1876. 8vo, pp. 34.

98. Vermont. [7.] (Oct. 1876?)—Report of the Fish Commissioners for the State of Vermont, for 1875-'76. Rutland: Tuttle & Company, printers. 1872. 8vo, pp. 16.

99. **New Jersey.** [7.] (Nov. 14. 1876?)—Seventh Annual Report of the Commissioners of Fisheries of the State of New Jersey, for the year 1876. Trenton, N. J.: John L. Murphy, book and job printer. 1876. 8vo, pp. 47.

100. **Virginia.** [3.] (Nov. 30, 1876.)—Annual Report of the Fish Commissioners of the State of Virginia, for the year 1876. Richmond: R. F. Walker, superintendent public printing. 1876. 8vo, pp. 13.

101. **Maine.** [10.] (Dec. 9, 1876?)—Tenth Report of the Commissioners of Fisheries of the State of Maine, for the year 1876. Augusta: Sprague, Owen & Nash, printers to the State. 1876. 8vo, pp. 31.

102. **Michigan.** [2.] (Dec. 20, 1876?)—Second Report of the State Fish Commissioners and Superintendent on State Fisheries, for 1875–'6, ending December 20, 1876. By authority. Lansing: W. S. George & Son, State printers and binders. 1876. 8vo, pp. 67.

103. **Wisconsin.** [3.] (Dec. 21, 1876.)—Third Annual Report of the Commissioners of Fisheries of the State of Wisconsin, for the year 1876. Madison, Wis.: E. B. Bolens, State printer. 1876. 8vo, pp. 23.

104. **Massachusetts.** [12.] (Dec. 31, 1876?)—Eleventh Annual Report of the Commissioners on Inland Fisheries, for the year ending January 1, 1877. Boston: Albert J. Wright, State printer, 79 Milk street (corner of Federal). 1877. 8vo, pp. 50.

105. **Minnesota.** [3.] (Dec., 1876?)—Third Annual Report of the State Fish Commissioners of Minnesota, for the fiscal year ending December 31, 1876. Printed by order of the legislature. Saint Paul: Pioneer Press Company. 1877. 8vo, pp. 14.

105½. **Georgia.** [1.] (Dec. 31, 1876?)—Third Annual Report of the Commissioner of Agriculture of the State of Georgia, for the year 1876. Atlanta, Ga.: 1877. 8vo, pp. 6–7.

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106. **Connecticut.** [11.] (Jan. 1, 1877.)—Eleventh Report of the Commissioners on Fisheries of the State of Connecticut, 1877. Hartford: Press of the Case, Lockwood & Brainard Company. 1877. 8vo, pp. 33.

107. **Rhode Island.** [10.] (Jan. 1, 1877.)—Annual Report of the Commissioners on Inland Fisheries, made to the general assembly of the State of Rhode Island, at its January session, A. D. 1877. Providence: Angell, Burlingame & Co., printers to the State. 1877. 8vo, pp. 11.

108. **Maryland.** [5.] (Jan. 1, 1877?)—Report of a Commissioner of Fisheries of Maryland, January, 1877. King Brothers, printers, 162 West Baltimore street. 1877. 8vo. pp. 108, pl. 2, 1 cut.

109. Ohio. [2.] (Jan. 13, 1877.)—First Annual Report of the Ohio State Fish Commission, to the Governor of the State of Ohio, for the years 1875 and 1876. Columbus: Nevins & Myers, State printers. 1877. 8vo, pp. 96, pl. 13.

110. Pennsylvania. [5.] (Feb. 7, 1877.)—Commonwealth of Pennsylvania. Report of the State Commissioners of Fisheries, for the year 1876. Harrisburg: B. F. Meyers, State printer. 1877. 8vo, pp. 28.

111. New York. [9.] (Feb., 1877.)—Ninth Annual Report of the Commissioners of Fisheries of the State of New York, for the year ending December 31, 1876. Transmitted to the legislature February 27, 1877. Jerome B. Parmenter, State printer. 1877. 8vo, pp. 20.

112. New Hampshire. [13.] (May 19, 1877.?)—Report of the Fish Commissioners of New Hampshire, June session, 1877. Concord: Edward A. Jenks, State printer. 1877. 8vo, pp. 45.

113. Iowa. [2.] Oct. 13, 1877.)—Second Biennial Report of the State Fish Commission of Iowa, being reports for the years 1875–'6 and 1876–'7. Des Moines: R. P. Clarkson, State printer. 1877. 8vo, pp. 37.

114. Kentucky. [1.] (Nov. 1, 1877.)—First Report of the Fish Commissioners of Kentucky, for the year ending November 1, 1877. Property of the State of Kentucky. Frankfort, Ky.: Printed at the Kentucky Yeoman office, S. I. M. Major, public printer. 1878. 8vo, pp. 22.

115. California. [5.] (Nov. 10, 1877.)—Report of the Commissioners of Fisheries of the State of California, for the years 1876 and 1877. 8vo, pp. 30.

116. Virginia. [4.] (Nov. 20, 1877.)—Annual Report of the Fish Commissioner of the State of Virginia, for the year 1877. Richmond: R. F. Walker, superintendent public printing. 1877. 8vo, pp. 60.

117. Maine. [11.] Nov. 30, 1877.?)—Eleventh Report of the Commissioners of Fisheries of the State of Maine, for the year 1877. Augusta: Sprague, Owen & Nash, printers to the State. 1877. 8vo, pp. 30.

118. Wisconsin. [4.] (Nov., 1877.)—Fourth Annual Report of the Commissioners of Fisheries of the State of Wisconsin, for the fiscal year ending September 30, 1877. Madison, Wis.: David Atwood, printer and stereotyper. 1877. 8vo, pp. 23.

119. Massachusetts. [13.] (Dec. 1, 1877.)—Twelfth Annual Report of the Commissioners on Inland Fisheries, for the year ending January 1, 1878. Boston: Rand, Avery & Co., printers to the Commonwealth, 117 Franklin street. 1878. 8vo, pp. 68, 1 map.

Vol. III, No. 7. Washington, D. C. August 9, 1883.

120. **New Jersey.** [8.] (Dec. 5, 1877.?)—Eighth Annual Report of the Commissioners of Fisheries of the State of New Jersey, for the year 1877. Trenton, N. J.: Naar, Day & Naar, printers. 1877. 8vo, pp. 63, pl. 2, 1 cut.

120½. **Georgia.** [2.] (Dec. 31, 1877.?)—Fourth Annual Report of the Commissioner of Agriculture of the State of Georgia, for the year 1877. Atlanta, Ga.: James P. Harrison & Co., printers and binders. 1878. 8vo, pp. 29–30.

121. **Minnesota.** [4.] (Dec., 1877.?)—Fourth Annual Report of the State Fish Commissioners of Minnesota, for the fiscal year ending December 31, 1877. Transmitted to the legislature of the twentieth annual session, 1878. Minneapolis: Johnson, Smith & Harrison. 1878. 8vo, pp. 24.

122. **Pennsylvania.** [6.] (Dec., 1877.?)—Report of Joint Special Committee on the operations of the Fish Department. Harrisburg: Lane S. Hart, State printer. 1878. 8vo, pp. 20, chart.

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123. **Connecticut.** [12.] (Jan. 1, 1878.)—Twelfth Report of the Commissioners on Fisheries of the State of Connecticut, 1878. Hartford: Press of the Case, Lockwood & Brainard Company. 1878. 8vo, pp. 24.

124. **Utah.** [3.] (Jan. 1, 1878.)—Report of A. P. Rockwood, Superintendent Zion's Co-operative Fish Association, 1871–1878. 8vo, pp. 14. (*Title page not seen.*)

125. **Maryland.** [6.] (Jan. 1, 1878.?)—Report of a Commissioner of Fisheries of Maryland. January, 1878. Baltimore: Printed by King Brothers, 162 West Baltimore street. 1878. 8vo, pp. 125, 5 tables, pl. 2 + VI, 1 cut.

126. **North Carolina.** [3.] (Jan. 15, 1878.)—Third Quarterly Report of Leonidas L. Polk, Commissioner, to the Board of Agriculture, Immigration, and Statistics. January 15, 1878. Raleigh: Farmer and Mechanic steam book and job office. 1877. 8vo, pp. 22. (Artificial Propagation of Fish, pp. 10–14.)

127. **Pennsylvania.** [7.] (Feb. 11, 1878.)—Commonwealth of Pennsylvania. Report of the State Commissioners of Fisheries, for the year 1877. Harrisburg: Lane S. Hart, State printer. 1878. 8vo, pp. 38, 1 cut.

128. **New York.** [10.] (Feb., 1878.)—Tenth Anuual Report of the New York Fishery Commissioners for the year 1877. Albany, N. Y.: Van Benthuysen Printing House. 1878. 8vo, pp. 47, pl. 3.

129. New Hampshire. [14.] (Apr. 1, 1878.?)—Report of the Fish Commissioners of New Hampshire, June session, 1878. Manchester: John B. Clarke, State printer. 1878. 8vo, pp. 75, pl. 3, 5 cuts.

130. Ohio. [3.] (Apr. 9, 1878.)—Second Annual Report of the Ohio State Fish Commission, made to the Governor of the State of Ohio, for the year 1877. Columbus: Nevins & Myers, State printers, 1878. 8vo, pp. 116, 16 cuts.

131. Rhode Island. [11.] (Apr. 9, 1878.)—State of Rhode Island and Providence Plantations. Eighth Annual Report of the Commissioners of Inland Fisheries, made to the general assembly, at the January session, A. D. 1878, together with the laws of the State now in force relating to inland fisheries. Office of the Secretary of State, April, 1878. Providence: G. L. Freeman & Co., printers to the State. 1878. 8vo, pp. 19.

132. Kansas. [1.] (June 30, 1878.)—First Biennial Report of the Commissioner of Fisheries of the State of Kansas, for the years 1877–'78. Topeka, Kans.: Geo. W. Martin, Kansas Publishing House. 1878. 8vo, pp. 20.

133. North Carolina. [2.] (Oct. 15, 1878.)—Second Quarterly Report of the Commissioner of Agriculture, for the year 1878 (embracing, also, the first quarter). Raleigh, N. C.: Farmer and Mechanic steam book and job print. 1878. 8vo, pp. 22. (Fish Propagation, pp. 5–7.)

134. Vermont. [8.] (Oct., 1878.)—Biennial Report of the Fish Commissioners of the State of Vermont, for 1877–'78. Rutland: Tuttle & Co., stationers and official printers to the State of Vermont. 1878. 8vo, pp. 24.

135. Massachusetts. [14.] (Oct., 1878.?)—Thirteenth Annual Report of the Commissioners on Inland Fisheries, for the year ending September 30, 1878. Boston: Rand, Avery & Co., printers to the Commonwealth, 117 Franklin street. 1879. 8vo, pp. 63.

136. Virginia. [5.] (Nov. 5, 1878.)—Annual Report of the Fish Commissioner of the State of Virginia, for the year 1878. Lexington, Va.: Lexington Gazette job office. 8vo, pp. 23.

137. West Virginia. [1.] (Nov. 22, 1878.)—Report of the Fish Commissioners of the State of West Virginia, for the years 1877–'78. Wheeling: W. J. Johnston, public printer, 1879. 8vo, pp. 28.

138. Michigan. [3.] (Dec. 20, 1878.?)—State of Michigan. Third Report of the Superintendent of the Michigan State Fisheries for 1877–'78, ending December 20, 1878. By authority. Lansing: W. S. George & Co., State printers and binders. 1879. 8vo, pp. 96.

139. Nevada. [1.] (Dec. 28, 1878.)—First Biennial Report of the Fish Commissioner of the State of Nevada, for the years 1877 and 1878. San Francisco: A. L. Bancroft & Company, printers, 721 Market street. 1879. 8vo, pp. 7.

140. **Wisconsin.** [5.] (Dec. 29, 1878.)—Fifth Annual Report of the Commissioners of Fisheries of the State of Wisconsin, for the year ending December 31, 1878. Madison, Wis.: David Atwood, State printer. 1879. 8vo, pp. 46, pl. 2.

141. **New Jersey.** [9.] (Dec. 31, 1878.)—Report of the Commissioners of Fisheries of the State of New Jersey, for the year 1878. Trenton, N. J.: Naar, Day & Naar, printers. 1878. 8vo, pp. 33.

142. **Maine.** [12.] (Dec. 31, 1878?)—Twelfth Report of the Commissioners of Fisheries of the State of Maine, for the year 1878. Augusta: Sprague, Owen & Nash, printers to the State. 1878. 8vo, pp. 26.

143. **Minnesota.** [5.] (Dec., 1878?)—Fifth Annual Report of the State Fish Commissioners of Minnesota, for the fiscal year ending December 31, 1878. Transmitted to the legislature of the twenty-first annual session, 1879. St. Paul: Miller & Rich, book and job printers, 28 East Third street. 1879. 8vo, pp. 22, 1 cut.

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144. **Connecticut.** [13.] (Jan. 1, 1879.)—Thirteenth Report of the Commissioners on Fisheries of the State of Connecticut, 1879. Hartford, Conn.: Press of the Case, Lockwood & Brainard Company. 1879. 8vo, pp. 34.

145. **Maryland.** [7.] (Jan. 1, 1879?)—Report of the Commissioners of Fisheries of Maryland, January, 1879. Annapolis: George Colton, State printer. 1879. 8vo. Frontispiece (plate of *Salmo salar*), pp. i–xl, followed by Public General Laws on Fish and Fisheries, 6 pages, and Public Local Laws on Fish and Fisheries, pp. 7–16.

146. **North Carolina.** [3.] (Jan. 6, 1879.)—Report of L. L. Polk, Commissioner of Agriculture. 1877–1878. 8vo, pp. 51. (Fish Propagation, pp. 7–15.)

147. **Ohio.** [4.] (Jan. 14, 1879.)—Third Annual Report of the Ohio State Fish Commission, made to the governor of the State of Ohio, for the year 1878. Columbus: Nevins & Myers, State printers. 1879. 8vo, pp. 22.

148. **Kansas.** [2.] (Jan. 25, 1879.)—Supplemental Report of Fish Commissioner for December, 1878. 8vo, pp. 3. (*Title page not seen.*)

149. **Pennsylvania.** [8.] (Feb. 20, 1879.)—Commonwealth of Pennsylvania. Report of the State Commissioners of Fisheries, for the year 1878. Presented in Senate February 20, 1870. Harrisburg: Lane S. Hart, State printer. 1879. 8vo, pp. 44, 1 cut.

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151. **New Hampshire.** [15.] (May 1, 1879?)—Report of the Fish Commissioners of New Hampshire, June session, 1879. Manchester: John B. Clarke, State printer. 1879. 8vo, pp. 51, pl. 3.

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154. **South Carolina.** [2.] (Oct. 31, 1879?)—Report of Fish Commissioner for the year 1879. 8vo, pp. 569–582. (*Title page not seen.*)

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165. **Virginia.** [7.] (Jan. 28, 1880.)—Report upon the Fisheries and Oyster Industries of Tidewater Virginia, with recommendations of such legislation as is necessary to regulate the same and derive a revenue from them. Made in obedience to a joint resolution of the general assembly, by M. McDonald, Commissioner of Fisheries of Virginia. Richmond: R. F. Walker, superintendent public printing. 1880. 8vo, pp. 20.

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167. **Rhode Island.** [12.] (Apr. 9, 1880?)—State of Rhode Island and Providence Plantations. Ninth Annual Report of the Commissioners of Inland Fisheries, made to the general assembly at its January session, 1880. Providence: E. L. Freeman & Co., printers to the State. 1880. 8vo, pp. 19, 3 diagrams.

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174. **Massachusetts.** [16.] (Oct., 1880?)—Fifteenth Annual Report of the Commissioners of Inland Fisheries for the year ending September 30, 1880. Boston: Rand, Avery & Co., printers to the commonwealth, 117 Franklin street. 1881. 8vo, pp. 77.

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(Inside title, erroneous.) Report of the Fish Commissioners of the State of West Virginia, for the years 1878–'79. Wheeling: W. J. Johnston, public printer. 1881.

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184. **Connecticut.** [15.] (Jan. 1, 1881.)—Fifteenth report of the Fish Commissioners of the State of Connecticut to the general assembly, January session, 1881. Middletown, Conn.: Pelton & King, printers and bookbinders. 1881. 8vo, pp. 32.

185. **Maryland.** [9.] (Jan. 1, 1881?)—Report of T. B. Ferguson, a Commissioner of Fisheries of Maryland. January, 1881. Hagerstown, Md.: Bell & Co., printers. 1881. 8vo, frontispiece, pp. cxiv, 1 diagram, 8 cuts, 16 plates, appendices (pp. 1–152), alphabetical index (paged 1–6).

Appendix A. An account of experiments on oyster culture and observations relating thereto, made at St. Jerome's Creek, Maryland, during the summer of 1880, by John A. Ryder. pp. 1–80, 15 figures. Notes on some of the early stages of development of the clam, or mananose (*Mya arenaria* Linn.), by John A. Ryder. pp. 81–91, 11 figures.

Appendix B. Oyster and fish laws, pp. 93–152.

Alphabetical index (separately paged) 1–6.

186. **Tennessee.** [1.] (Jan. 3, 1881.)—Biennial Report of the Fish Commissioner of the State of Tennessee to the forty-second general assembly. January 3, 1881. Geo. F. Akers, commissioner. Printed by act of general assembly. Nashville: Tavel, Eastman & Howell, printers to the State. 1881. 8vo, pp. 13.

187. **Ohio.** [6.] (Jan. 20, 1881.)—Fifth Annual Report of the Ohio Fish Commission made to the governor of the State of Ohio, for the year 1880. Columbus, Ohio: G. J. Brand & Co., State printers. 1881. 8vo, pp. 34.

188. **Missouri.** [1.] (Jan. 27, 1881.)—Report of the Fish Commissioners of the State of Missouri to the thirty-first general assembly. Jefferson City: Tribune Printing Company, State printers and binders. 1881. 8vo, pp. 42.

189. **California.** [7.] (Jan., 1881?)—Report of the Commissioners of Fisheries of the State of California for the year 1880. 8vo, pp. 70.

190. **Minnesota.** [6.] (Jan., 1881?)—The Sixth and Seventh Annual Reports of the Minnesota State Fish Commission for the years 1879 and 1880. Saint Peter: J. K. Moore, State printer. 1881. 8vo, pp. 32.

191. Pennsylvania. [9.] (Feb. 15, 1881.)—Report of the State Commissioners of Fisheries, for the years 1879 and 1880. Harrisburg: Lane S. Hart, State printer, 1881. 8vo, pp. 151, State seal on reverse of title-page, pl. 30 (26 illustrating fishes, embracing figs. 1–44), 2 diagrams.

192. Rhode Island. [13.] (Feb., 1881.)—State of Rhode Island and Providence Plantations. Tenth Annual Report of the Commissioners of Inland Fisheries, made to the general assembly, at its January session, A. D. 1881. Providence: E. L. Freeman & Co., printers to the State. 1881. 8vo, pp. 32.

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194. Kentucky. [3.] (Oct. 10, 1881.)—Third Biennial Report of the Fish Commission of Kentucky. Being reports for the years 1879–'80 and 1880–'81. Property of the State of Kentucky. Frankfort, Ky.: Printed at the Kentucky Yeoman office. S. I. M. Major, public printer. 1882. 8vo, pp. 26.

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196. South Carolina. [4.] (Oct. 31, 1881.)—Second Annual Report of the Commissioner of Agriculture of the State of South Carolina. 1881. Columbia, S. C.: James Woodrow, State printer. 1881. 8vo, pp. 131. On fish culture, see pp. 28–42 and 95.

197. Massachusetts. [17.] (Oct., 1881?)—Sixteenth Annual Report of the Commissioners on Inland Fisheries, for the year ending September 30, 1881. Boston: Rand, Avery & Co., printers to the Commonwealth, 117 Franklin Street. 1882. 8vo, pp. 62.

198. Connecticut. [16.] (Dec. 1, 1881.)—Sixteenth Annual Report of the Fish Commissioners, and First Report of the Shell-fish Commissioners of the State of Connecticut to the general assembly, January session, 1882. Hartford, Conn.: Press of the Case, Lockwood & Brainard Company. 1881. 8vo, pp. 33. (In same cover with No. 199.)

199. Connecticut. [17.] (Dec. 1, 1881.)—Report of the Commissioners of Shell-fisheries of Connecticut. Presented to the legislature, January session, 1882. Hartford, Conn.: Press of the Case, Lockwood & Brainard Company. 1882. 8vo, pp. 35–132, 2 folded maps. (In same cover with No. 198.)

200. Maine. [15.] (Dec. 31, 1881.)—Report of the Commissioner of Fisheries and Game of the State of Maine for the year 1881. Augusta: Sprague & Son, printers to the State. 1882. 8vo, pp. 31.

201. **Wisconsin.** [8.] (Dec. 31, 1881.)—Eighth Annual Report of the Commissioners of Fisheries for the State of Wisconsin for the year ending December 31, 1881. Madison, Wis.: David Atwood, State printer. 1882. 8vo, pp. 54.

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224. **Nevada.** [3.] (Jan. 4, 1883.)—Biennial Report of the Fish Commissioner of the State of Nevada, for the years 1881 and 1882. Carson, Nev.: J. C. Harlow, State printer. 1883. 8vo, pp. 11.

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228. **Virginia.** [8.] (Feb. 24, 1883.)—Annual Report of the Commissioner of Fisheries, 1882. Richmond: Johns & Goolsby, printers. 1882. 8vo, pp. 17. Appendix 31 pp., pl. 3, 1 cut.

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232. **North Carolina.** [6.] (Jan. (?), 1883.)—Report of the Board of Agriculture to the Honorable the General Assembly of the State of North Carolina, Document No. 18, session, 1883: [containing] Second Biennial Report of S. G. Worth, Superintendent of Fish and Fisheries of North Carolina. (Without cover,) 8vo, pp. 62–81.

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195. (4) Fourth Biennial R. of Cn. for 1879-'80, '1880-'81..Oct. 31, 1881 : 38 pp. 1882.

KANSAS.

132. (1) First Biennial R. of C. for years 1877-'78.....June 30, 1878 : 20 pp. 1878.
148. (2) Supplemental R. for December 1878 .....Jan. 25, 1879 : 3 pp. 1879.
169. (3) Second Biennial R. of C. [for years 1879-'80]....June 30, 1880 : 19 pp. 1880.
208. (4) Third Biennial R. of C. for years 1881-'82 .....June 30, 1882 : 69 pp. 1883.

KENTUCKY.

114. (1) First R. of Cs. for year ending Nov. 1, 1877.....Nov. 1, 1877 : 22 pp. 1878.
157. (2) Second Biennial R. of Cn. for 1877-'78, 1878-'79....Nov. 1, 1879 : 30 pp. 1879.
194. (3) Third Biennial R. of Cn. for 1879-'80, 1880-'81.....Oct. 10, 1881 : 26 pp. 1882.

MAINE.

10. (1) First R. of Cs. for the year 1867 .....Jan. 16, 1868 : 96 pp. 1869.
14. (2)* Second R. of Cs. for the year 1868.....Dec. 31, 1868 : 45 pp. 1869.
23. (3) Third R. of C. for the year 1869.....Dec. 31, 1869 : 48 pp. 1870.
31. (4) Fourth R. of C. for the year 1870.....Dec. 31, 1870 : 56 pp. 1870.
40. (5) Fifth R. of C. for the year 1871.....Dec. 31, 1871 : 31 pp. 1872.
52. (6) Sixth R. of Cs. for the year 1872.....Dec. 31, 1872 ? : 16 pp. 1873.
60. (7) Seventh R. of Cs. for the year 1873.....Dec. 31, 1873 ? : 39 pp. 1873.
74. (8) Eighth R. of Cs. for the year 1874 .....Nov. 30, 1874 : 32 pp. 1874.
85. (9) Ninth R. of Cs. for the year 1875.....Dec. 9, 1875 ? : 40 pp. 1875.
101. (10) Tenth R. of Cs. for the year 1876 .....Dec. 9, 1876 ? : 31 pp. 1876.
117. (11) Eleventh R. of Cs. for the year 1877.....Nov. 31, 1877 ? : 30 pp. 1877.
142. (12) Twelfth R. of Cs. for the year 1878.....Dec. 31, 1878 ? : 26 pp. 1878.
150. (13) [Thirteenth] R. of C. for the year 1879.....Dec. 31, 1879 ? : 35 pp. 1879.

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183. (14) [Fourteenth] R. of C. for the year 1880.....Dec. 31, 1880 ? : 55 pp. 1880.
200. (15) [Fifteenth] R. of C. for the year 1881 .....Dec. 31, 1881 : 31 pp. 1882.
215. (16) [Sixteenth] R of C. for the year 1882 .....Dec. 1, 1882 : 38 pp. 1882.

MARYLAND.

21. (1) R. upon oyster resources in Maryland .....Oct., 1869 : 20 pp. 1870.
43. (2) R on oyster fisheries, shad and herring fisheries, &c. Jan., 1872 : 48 pp. 1872.
65. (3) R. of Commander of oyster fisheries, &c .....Jan. 1, 1874 : 11 pp. 1874.
92. (4) R. of Cs. to General Assembly, Jan. 1, 1876 .....Jan. 1, 1876 : 239 pp. 1876.
108. (5) R. of a C., January, 1877.....Jan. 1, 1877 ? : 108 pp. 1877.
125. (6) R. of a C., January, 1878.....Jan. 1, 1878 ? : 156 pp. 1878.
145. (7) R. of Cs., January, 1879.....Jan. 1, 1879 ? : 56 pp. 1879.
162. (8) R. of Cs., January, 1880 .....Jan. 1, 1880 ? : 355 pp. 1880.
185. (9) R. of T. B. Ferguson, a C., January, 1881.....Jan. 1, 1881 ? : 294 pp. 1881.
(10) R. of Thos. Hughlett, a C., January, 1881.....Jan. 1, 1881 ? : Unpublished.
202. (11) R. of Thos. Hughlett, a C., January, 1882. ....Jan. 1, 1882 ? : 32 pp. 1882.
218. (12) R. of Cs., January, 1883 .....Dec. 19, 1882 : 31 pp. 1883.

MASSACHUSETTS.

1. (1) R. of Cs., appointed 1856; Chap. 58.....May 5, 1857 : 54 pp. 1857.
4. (2) [First] R. of Cs., under resolve of May 3, 1865. Dec. 1, 1865 : 77 pp. 1866?
11. (3) [Second] R. of Cs. for year ending Jan. 1, 1868..Jan., 1868 : 50 pp. 1868.
15. (4) [Third] R. of Cs. for year ending Jan. 1, 1869..Jan., 1869 : 71 pp. 1869.
25. (5) [Fourth] R. of Cs. for year ending Jan. 1, 1870. Jan., 1870 : 67 pp. 1870.
35. (6) Fifth R. of Cs. [for year ending] January, 1871. Jan., 1871 : 77 pp. 1871.
46. (7) Sixth R. of Cs. for year ending Jan. 1, 1872...Jan., 1872 : 270 pp. 1872.
54. (8) Seventh R. of Cs. for year ending Jan. 1, 1873..Jan., 1873 : 35 pp. 1872.
59. (9) Eighth R. of Cs. for year ending Jan. 1, 1874...Dec. 1, 1873 : 63 pp. 1874.
75. (10) Ninth R. of Cs. for year ending Jan. 1, 1875...Dec. 1, 1874 : 57 pp. 1875.
86. (11) Tenth R. of Cs. for year ending Jan. 1, 1876...Dec. 15, 1875 ? : 72 pp. 1876.
104. (12) Eleventh R. of Cs. for year ending Jan. 1, 1877. Dec. 31, 1876 ? : 50 pp. 1877.
119. (13) Twelfth R. of Cs. for year ending Jan. 1, 1878..Dec. 1, 1877 : 68 pp. 1878.
135. (14) Thirteenth R. of Cs. for year end'g Sept. 30, 1878 Oct., 1878 ? : 63 pp. 1879.
155. (15) Fourteenth R. of Cs. for year end'g Sept. 30, 1879. Oct., 1879 ? : 50 pp. 1880.
174. (16) Fifteenth R. of Cs. for year end'g Sept. 30, 1880. Oct., 1880 ? : 77 pp. 1881.
197. (17) Sixteenth R. of Cs. for year end'g Sept. 30, 1881. Oct., 1881 ? : 62 pp. 1882.
222. (18) Seventeenth R. of Cs. year end'g. Dec 31, 1882. Dec., 1882 ? : 58 pp. 1883.

MICHIGAN.

77. (1) First [Biennial] R. of Cs. and Supt. for 1873–'74, ending Dec. 1, 1874 .....Dec. 1, 1874 : 67 pp. 1875.
102. (2) Second [Biennial] R. of Cs. and Supt. for 1875–'76, ending Dec. 20, 1876 .....Dec. 20, 1876 ? : 67 pp. 1876.
133. (3) Third [Biennial] R. of Supt. for 1877–'78, ending Dec. 20, 1878 .....Dec. 20, 1878 ? : 96 pp. 1879.
176. (4) Fourth [Biennial] R. of Cs. and Supt. for 1879–'80, ending Dec. 1, 1880 .....Dec. 1, 1880 : 52 pp. 1881.
216. (5) Fifth Biennial R. of Supt. for 1881–'82, ending Dec. 1, 1882 .....Dec. 1, 1882 : 26 pp. 1883.

MINNESOTA.

80. (1) First R. of Cs. [for year ending Dec. 31, 1874]....Feb. 20, 1875 : 30 pp. 1875.
91. (2) Second R. of Cs. [for year ending Dec. 31, 1875] ..Dec., 1875 ? : 19 pp. 1876.

105. (3) Third R. of Cs. for year ending Dec. 31, 1876...Dec., 1876?: 14 pp. 1877.
121. (4) Fourth R. of Cs. for year ending Dec. 31, 1877..Dec., 1877?: 34 pp. 1878.
143. (5) Fifth R. of Cs. for year ending Dec. 31, 1878....Dec., 1878?: 22 pp. 1879.
190. (6) Sixth and seventh R. of Cn. for 1879 and 1880...Jan., 1881?: 32 pp. 1881.
217. (7) Eighth [and ninth] R. of Cn. for 1881–'82.....Dec. 1, 1882: 84 pp. 1883.

MISSOURI.

188. (1) [First] R. of Cs. [for 1880] .....Jan. 27, 1881: 42 pp. 1881.
229. (2) [Second] R. of Cn. for the years 1881 and 1882..Jan. 26, 1883: 62 pp. 1883.

NEBRASKA.

163. (1) [First] R. of Cs. for the year 1879 ..... Jan. 1, 1880?: 16 pp. 1880.
179. (2) Second R. of Cs. [for year ending] Dec. 31, '80 ..Dec. 31, 1880: 19 pp. 1881.
219. (3) Third R. of Cs. [for year ending] Dec. 31, 1882 ..Dec. 31, 1882: 13 pp. 1883.
220. (4)* Fourth R. of Cs. [for year ending] Dec. 31, '82 ..Dec. 31, 1882: 22 pp. 1883.

NEVADA.

139. (1) First Biennial R. of C. for years 1877 and 1878....Dec. 28, 1878: 7 pp. 1879.
180. (2) Second Biennial R. of C. for years 1879 and 1880...Dec. 31, 1880: 10 pp. 1881.
224. (3) [Third] Biennial R. of C. for years 1881 and 1882..Jan. 4, 1883: 11 pp. 1883.

NEW HAMPSHIRE.

3. (1) R. of select committee, June session, 1865.....July 1, 1865: 8 pp. 1865.
5. (2) R. of Cs., June session, 1866 .....June 1, 1866: 16 pp. 1866.
8. (3) R. of Cs., June session, 1867 .....July 5, 1867: 17 pp. ms. c.
13. (4) R. of Cs., June session, 1868.....June 18, 1868: 8 pp. 1868.
19. (5) R. of Cs., June session, 1869 .....June 21, 1869: 10 pp. 1869.
28. (6) R. of Cs., June session, 1870.....June 10, 1870: 15 pp. 1870.
38. (7) R. of Cs., June session, 1871 .....May 29, 1871: 11 pp. 1871.
50. (8) R. of Cs., June session, 1872.....May 27, 1872: 15 pp. 1872.
58. (9) R. of Cs., June session, 1873 .....May 30, 1873: 13 pp. 1873.
71. (10) R. of Cs., June session, 1874 .....May 20, 1874: 15 pp. 1874.
87. (11) R. of Cs., June session, 1875 .....Feb. 20, 1875: 16 pp. 1875.
96. (12) R. of Cs., June session, 1876. .....Mar. 2, 1876: 16 pp. 1876.
112. (13) R. of Cs., June session, 1877.....May 19, 1877?: 45 pp. 1877.
129. (14) R. of Cs., June session, 1878.....April 1, 1878?: 75 pp. 1878.
151. (15) R. of Cs., June session, 1879.....May 1, 1879?: 51 pp. 1879.
168. (16) R. of Cs., June [session], 1880 .....June 1, 1880?: 61 pp. 1880.
193. (17) R. of Cs., June session, 1881.....June 1, 1881?: 90 pp. 1881.
207. (18) R. of Fish and Game Cs., 1881–'82 .....June 1, 1882?: 47 pp. 1882.

NEW JERSEY.

32. (1) First R. of Cs. [for the year 1870], 1871 .....Dec., 1870?: 25 pp. 1871.
42. (2) Second R. of Cs. [for the year 1871], 1872 .....Dec., 1871?: 22 pp. 1872.
53. (3) Third R. of Cs. for the year 1872 .....Dec., 1872?: 28 pp. 1872.
64. (4) Fourth R. of Cs. for the year 1873 .....Dec., 1873?: 32 pp. 1873.
73. (5) Fifth R. of Cs. for the year 1874.....Nov. 14, 1874?: 62 pp. 1884.
84. (6) Sixth R. of Cs. for the year 1875.....Nov. 14, 1875?: 29 pp. 1875.
99. (7) Seventh R. of Cs. for the year 1876 .....Nov. 14, 1876?: 47 pp. 1876.
120. (8) Eighth R. of Cs. for the year 1877.....Dec. 5, 1877?: 65 pp. 1877.
141. (9) [Ninth] R. of Cs. for the year 1878.....Dec. 31, 1878 : 33 pp. 1878.

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17.	(1) [First] R. of Cs. to legislature, March 9, 1869	Mar. 9, 1869	: 75 pp.	1869.
26.	(2) [Second] R. of Cs. to legislature. March 11, '70	Mar. 11, 1870	: 20 pp.	1870.
36.	(3) [Third] R. of Cs. to legislature, Feb. 28, 1871	Feb. 1, 1871	: 32 pp.	1871.
48.	(4) Fourth R. of Cs. to legislature, March 19, '72	Mar. 19, 1872?	: 34 pp.	1872.
55.	(5) [Fifth] R. of Cs. to legislature, Feb. 12, 1873	Jan., 1873	: 32 pp.	1873.
67.	(6) [Sixth] R. of Cs. to legislature, Feb. 5, 1874	Jan., 1874	: 41 pp.	1874.
79.	(7) Seventh R. of Cs. to legislature, Feb. 1, 1875	Jan., 1875	: 61 pp.	1875.
95.	(8) Eighth R. of Cs. for year ending Dec. 31, 1875	Feb., 1876	: 59 pp.	1876.
111.	(9) Ninth R. of Cs. for year ending Dec. 31, 1876	Feb., 1877	: 20 pp.	1877.
128.	(10) Tenth R. of Cs. for year 1877	Feb., 1878	: 50 pp.	1878.
166.	(11) Eleventh R. of Cs. for 2 yrs. ending Dec. 31, '79	April 1, 1880	: 45 pp.	1880?
206.	(12) [Twelfth] R. of Cs. for the year 1881	April 1, 1882	: 83 pp.	1882.

NORTH CAROLINA.

126.	(1) Third Qr. of C., January 15, 1878	Jan. 15, 1878	: pp. 10–14.	1877.
133.	(2) Second Qr. of C. of Agric. for the year 1878	Oct. 15, 1878	: pp. 5–8.	1878.
146.	(3) R. of Supt. [in R. of C. of Agric., 1877–'78	Jan. 6, 1879	: 7–15 pp.	1879?
150.	(4) Fish Culture in North Carolina, 1879	April 1, 1879	: 26 pp.	1879?
178.	(5) R. of Supt. [in R. of C. of Agric., 1879–'80]	Dec. 31, 1880?	: pp. 25–51.	1881.
232.	(6) Second Bennial R. of Supt., 1881-82 [In R. of C. of Agric., 1883.]	Dec. 31, 1882	: pp. 62–81.	1883.

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69.	(1) R. of Cs. for year ending December, 1873	Feb. 23, 1874	: 40 pp.	1874.
109.	(2) First R. of Cn. for years 1875 and 1876	Jan. 13, 1877	: 96 pp.	1877.
130.	(3) Second R. of Cn. for year 1877	April 9, 1878	: 116 pp.	1878.
147.	(4) Third R. of Cn. for year 1878	Jan. 14, 1879	: 22 pp.	1879.
164.	(5) Fourth R. of Cn. for year 1879	Jan. 15, 1880	: 35 pp.	1880.
187.	(6) Fifth R. of Cn. for year 1880	Jan. 20, 1881	: 34 pp.	1881.
205.	(7) Sixth R. of Cn. for year 1881	Jan. 28, 1882	: 19 pp.	1882.
231.	(8) Seventh R. of Cn. for year 1882	Jan. 29, 1883	: 14 pp.	1882.

PENNSYLVANIA.

33.	(1) R. of C. for the year 1870	Jan. 23. 1871	: 48 pp.	1871.
44.	(2) R. of C. for the year 1871	Jan. 16, 1872	: 24 pp.	1872.
63.	(3) R. of Cs. for the year 1873	Dec. 31, 1873?	: 32 pp.	1874.
88.	(4) R. of Cs. for the year 1874	Dec. 31, 1875?	: 29 pp.	1875.
110.	(5) R. of Cs. for the years 1875 and 1876	Feb. 7, 1877	: 28 pp.	1877.
122.	(6) R. of Special Committee	Dec., 1877?	: 20 pp.	1878.
127.	(7) R. of Cs. for the year 1877	Feb. 11, 1878	: 38 pp.	1878.
149.	(8) R. of Cs. for the year 1878	Feb. 20, 1879	: 44 pp.	1879.
191.	(9) R. of Cs. for the years 1879 and 1880	Feb. 15, 1881	: 151 pp.	1881.

RHODE ISLAND.

16.	(1) R. of Cs. to General Assembly, Jan., 1869	Feb. 15, 1869	: 36 pp.	1869?
24.	(2) R. of Com. [to Genl. Assem.], Jan. sess., 1870	Jan. 1870	: 9 pp.	1870.
29.	(3) R. of Com. of Genl. Assembly, May sess., 1870	June 15, 1870	: 159 pp.	1870.
34.	(4) [First] R. of Cs. [to G. A.], Jan. sess., 1870	Jan. 25, 1871	: 4 pp.	1871?
47.	(5) [Second] R. of Cs. [to G. A., Jan. sess., 1872	Feb. 23, 1872	: 16 pp.	1872.
56.	(6) Third R. of Cs. to G. A., Jan. sess., 1873	Feb. 24, 1873	: 12 pp.	1873.
68.	(7) Fourth R. of Cs. to G. A., Jan. sess., 1873	Feb. 19, 1874	: 10 pp.	1874.
78.	(8) Fifth R. of Cs. to G. A., Jan. sess., 1875	Jan. 30, 1875	: 20 pp.	1875.

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94. (9) [Sixth] R. of Cs. to G. A., Jan. sess., 1876.....Feb. 29, 1876: 11 pp. 1876.
107. (10) [Seventh] R. of Cs. to G. A., Jan. sess., 1877.Jan. 1, 1877: 11 pp. 1877.
131. (11) Eighth R. of Cs. to G. A., Jan. sess., 1878.....Apr. 9, 1878: 19 pp. 1878.
167. (12) Ninth R. of Cs. to G. A., Jan. sess., 1880.....Apr. 9, 1880?: 19 pp. 1880.
192. (13) Tenth R. of Cs. to G. A., Jan. sess., 1881.....Feb. 1881: 32 pp. 1881.
203. (14) Eleventh R. of Cs. to G. A., Jan. sess., 1882....Jan. 5, 1882: 10 pp. 1882.

SOUTH CAROLINA.

22. (1) R. on Fish, of Agr. and Mech. Soc..Nov. 10, 1869: pp. 21–26 and 45–47. 1869.
154. (2) [First] R. of C. for the year 1879.....Oct. 31, 1879?: pp. 569–582. 1880?
172. (3) [Second] R. of Supt. [R. of C. of Agr., 1880]..Oct. 23, 1880: pp. 12–17. 1880.
196. (4) [Third] R. of Supt. [R. of C. of Agr., 1881].Oct. 31, 1881: pp. 28–42, 95. 1881.

TENNESSEE.

186. (1) Bienn. R. of C. to Gen. Assem., Jan. 3, 1881.....Jan. 3, 1881: 13 pp. 1881.
230. (2) [Second] R. of Cs. for 1881–'82.....Jan. (?), 1883: 24 pp. 1883.

TEXAS.

177. (1) First R. of C. for the year 1880 .....Dec. 1, 1880: 26 pp. 1880.
223. (2) R. of C. for the year 1882 .....Jan. 1, 1883: 13 pp. 1883.

UTAH.

66. (1) R. of Deseret Agr. and Mfg. Soc. for 1872–'73...Jan. 1, 1874: pp. 5–7. 1874?
93. (2) R. of Deseret Agr. and Mfg. Soc. for 1875.....Feb. 14, 1876: pp. 8–9. 1876.
124. (3) R. of Supt. of Zion's Fish Assoc'n, 1871–'77 ....Jan. 1, 1878: 14 pp. 1878?

VERMONT.

2. (1) R. on propagation of fish.....Oct. 22, 1857: 64 pp. 1857.
6. (2) R. of Cs. to annual session, 1866 .....Oct. 11, 1866. 35 pp. 1866.
9. (3) R. of Cs. for the year 1867 .....Oct. 25, 1867: 25 pp. 1867.
20. (4) R. of Cs. for the year 1869 .....Oct. 25, 1869: 16 pp. 1869.
51. (5) [Biennial] R. of Cs. for the years 1871–'72 .....Oct. 29, 1872: 20 pp. 1872.
72. (6) [Biennial] R. of Cs. for the years 1873–'74 .....Oct. 27, 1874: 80 pp. 1874.
98. (7) [Biennial] R. of Cs. for [the years] 1875–'76 .....Oct. —, 1876?: 16 pp. 1876.
134. (8) Biennial R. of Cs. for 1877–'78 .....Oct. —, 1878: 24 pp. 1878.
173. (9) Biennial R. of Cs. for 1879–'80.....Oct. 26, 1880: 10 pp. 1880.
211. (10) Biennial R. of Cs. for 1881–'82 .....Nov. 15, 1882: 23 pp. 1882.

VIRGINIA.

39. (1) Report to the Auditor on the oyster beds, &c.....Oct. 1, 1871: 21 pp. 1872.
89. (2) R. of Cs. for the 1875.....Dec. 31, 1875?: 34 pp. 1875.
100. (3) R. of Cs. for the year 1876.....Nov. 30, 1876: 13 pp. 1876.
116. (4) R. of C. for the year 1877 .....Nov. 20, 1877: 60 pp. 1877.
136. (5) R. of C. for the year 1878 .....Nov. 5, 1878: 25 pp. 1878?
158. (6) R. of C. for the year 1879.....Nov. 1, 1879: 23 pp. 1879.
165. (7) R. of C. on fisheries and oysters .....Jan. 28, 1880: 20 pp. 1880.
228. (8) R. of C. [for three years ending Oct. 1], 1882....Feb. 24, 1883: 31 pp. 1882.

WASHINGTON.

153. (1) R. of C. [for the year] 1879 ..... Oct. 1, 1879: 4 pp. 1879.

WEST VIRGINIA.

137. (1) R. of Cs. for the years 1877–'78 ..... Nov. 22, 1878: 28 pp. 1879.
181. (2) R. of Cs. for the years 1879–'80 ..... Dec. 31, 1880: 16 pp. 1881.
204. (3) R. of Cs. for the year 1881 ..... Jan. 26, 1882? 37 pp. 1882.

WISCONSIN.

75. (1) First R. of Cs. [for year ending Dec. 31, 1874] ... Dec. —, 1874: 8 pp. 1875.
90. (2) Second R. of Cs. [for year ending Dec. 31, 1875] .. Dec. —, 1875: 15 pp. 1875.
103. (3) Third R. of Cs. for year [ending Dec. 31] 1876 ... Dec. 21, 1876: 23 pp. 1876.
118. (4) Fourth R. of Cs. for year ending Sept. 30, 1877 .... Nov. —, 1877: 23 pp. 1877.
140. (5) Fifth R. of Cs. for year ending Dec. 31, 1878 ..... Dec. 29, 1878: 46 pp. 1879.
160. (6) Sixth R. of Cs. for year ending Dec. 31, 1879 ..... Dec. 31, 1879?: 36 pp. 1880.
182. (7) Seventh R. of Cs. for year ending Dec. 31, 1880 ... Dec. 29, 1880: 44 pp. 1881.
201. (8) Eighth R. of Cs. for year ending Dec. 31, 1881 .... Dec. 31, 1881: 54 pp. 1882.
221. (9) Ninth R. of Cs. for year ending Dec. 31, 1882 ..... Dec. 31, 1882: 52 pp. 1883.

RECAPITULATION.

[Years in which each State commission has issued reports.]

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Vermont	'57, —, '66, '67, —, '69, —, —, '72, —, '74, —, '76, —, '78, —, '80, —, '82, —
New Hampshire	'65, '66, '67, '68, '69, '70, '71, '72, '73, '74, '75, '76, '77, '78, '79, '80, '81, '82, —
Connecticut	'67, '68, '69, '70, '71, '72, '73, '74, '75, '76, '77, '78, '79, '80, '81³, '82², —
Maine	'67, '68, '69, '70, '71, '72, '73, '74, '75, '76, '77, '78, '79, '80, '81, '82, —
Rhode Island	'69, '70², '71, '72, '73, '74, '75, '76, '77, '78, —, '80, '81, '82, —
New York	'69, '70, '71, '72, '73, '74, '75, '76, '77, '78, —, '80, —, '82, —
Maryland	'69, —, —, '72, —, '74, —, '76, '77, '78, '79, '80, '81, '82², —
South Carolina	'69, —, —, —, —, —, —, —, —, —, '79, '80, '81, —, —
New Jersey	'70, '71, '72, '73, '74, '75, '76, '77, '78, —, —, —, —, —
Alabama	'70, —, '72, —, —, —, —, —, —, —, —, —, —, —
Pennsylvania	'71, '72, '73, —, '75, —, '77², '78, '79, —, '81, —, —
Virginia	'71, —, —, —, '75, '76, '77, '78, '79, '80, —, —, '83
California	'71, —, '73², —, '75, —, '77, —, '79, —, '81, —, '83
Utah	'74, —, '76, —, '78, —, —, —, —, —
Ohio	'74, —, —, '77, '78, '79, '80, '81, '82, '83
Michigan	'74, —, '76, —, '78, —, '80, —, '82, —
Wisconsin	'74, '75, '76, '77, '78, '79, '80, '81, '82, —
Minnesota	'74, '75, '76, '77, '78, —, —, '81, '82, —
Iowa	'75, —, '77, —, '79, —, '81, —, —
Georgia	'76, '77, —, —, '80, —, '82, —
Kentucky	'77, —, '79, —, '81, —, —
North Carolina	'78², '79², '80, —, '82, —
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Texas	'80, —, —, '83
Tennessee	'81, —, '83
Missouri	'81, —, '83
Indiana	'83
Delaware	'83

4.—THE ORGANIZATION AND PERSONNEL OF THE UNITED STATES FISH COMMISSION, JUNE 1, 1883.

By CHAS. W. SMILEY.

[HEADQUARTERS, 1443 MASSACHUSETTS AVENUE, WASHINGTON, D. C.]

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- Edward Hayes, Stenographer.

Division of Accounts:
- H. A. Gill, Disbursing Agent and Chief of Division.
- Miss Fannie A. Rhees, Clerk.
- W. J. Murphy, Clerk.

Division of Mailing:
- J. P. Wilson.

Division of Records and Publication:
- Chas. W. Smiley, Editor of Publications and Chief of Division.
- Chas. W. Scudder, Clerk.
- Miss Julia Rockwell, Indexer.
- Clarence E. Latimer, Clerk.
- Merwin P. Snell, Stenographer.

Division of Distribution:
- Marshall McDonald, Chief of Division.
- James S. Goldsmith, Clerk.
- J. J. O'Conner, Stenographer.
- George H. H. Moore, Conductor of Car No. 1: Four Assistants.
- J. Frank Ellis, Conductor of Car No. 2: Four Assistants.
- G. G. Davenport, Distributing Agent.

Division of Property:
- Lieut. W. C. Babcock, U. S. N., Chief of Division.
- Miss E. M. Marbury, Clerk.

STATIONS.

Central Hatching and Distributing Station (Shad, Salmon, Whitefish, &c.):
- M. McDonald, Superintendent.
- W. F. Page, in charge of Propagation.
- John E. Brown, in charge of Property and Transportation.

Havre de Grace Station (Shad and Herring):
- Frank N. Clark, Superintendent; two watchmen.

McCloud River Station (Salmon and Trout):
- Livingston Stone, Superintendent.
- Myron Green, Chief Assistant.

Bucksport and Grand Lake Stream Salmon Stations (Schoodic and Penobscot Salmon):
- Chas. G. Atkins, Superintendent.
- H. H. Buck, Chief Assistant.

Northville and Alpena Stations (Whitefish, Trout, &c.):
Frank N. Clark, Superintendent.
Seymour Bower, Chief Assistant.
Washington Carp Ponds (Carp):
Rudolph Hessel, Superintendent; six watchmen.
Six Watchmen.
Gloucester Station (Reports of Cod and Mackerel Fisheries).
S. J. Martin, Custodian.
Wood's Holl Station (Cod, &c.).*
Vinal N. Edwards, Custodian.
Saint Jerome Station (Oysters):
Pinckney Hopewill, Watchman.
Wytheville Station (Trout, &c.):
George A. Seagle, in charge.
Fort Washington Station (Shad and Herring):
Lieut. W. C. Babcock, U. S. N., Superintendent.

STEAMERS.

U. S. S. Albatross (385.82 tons, signal letters G. V. Q. B.):
Lieut. Commander Z. L. Tanner, U. S. N., Commanding Officer.
Lieut. Seaton Schroeder, U. S. N., Executive Officer and Navigator; in charge of Hydrography and Metrology.
Lieut. Sidney H. May, U. S. N., Watch Officer; in charge of Sounding Apparatus.
Lieut. A. C. Baker, U. S. N., Watch Officer; in charge of Dredging Apparatus.
Ensign Clifford J. Boush, U. S. N., Watch Officer; in charge of Electric Apparatus.
Ensign R. H. Miner, U. S. N., Recording Officer; in charge of Marine Vertebrates.
Surgeon Jerome H. Kidder, U. S. N., Medical Officer; in charge of Chemistry.
Paymaster George H. Read, U. S. N., Pay Officer; in charge of Photography.
Passed Asst. Engineer George W. Baird, U. S. N., Chief Engineer; in charge of Special Mechanical Appliances.
James E. Benedict, Resident Naturalist.
U. S. S. Fish Hawk (205.71 tons, signal letters G. V. Q. C.):
Lieut. W. M. Wood, U. S. N., Commanding Officer.
James A. Smith, Mate and Executive Officer.
D. H. Cleaveland, Mate.
Wm. L. Bailie, Passed Asst. Engineer, Acting Chief Engineer.
J. Allan Kite, M. D., Civilian, Apothecary.
U. S. S. Lookout (28.76 tons, signal letters G. V. Q. D.):
William Hamlen, Chief Boatswain's Mate, in charge.

* The Commissioner will organize this station in person about July 1.

5.—A LIST OF THE NAMES AND ADDRESSES OF THE FISH COMMISSIONERS OF THE VARIOUS STATES OF THE UNITED STATES, AND OF SUPERINTENDENTS OF HATCHERIES; CORRECTED TO JUNE 1, 1883, WITH SOME INDICATION OF THE LIMITS OF THE TERMS UPON WHICH THEY ARE NOW SERVING.*

By CHAS. W. SMILEY.

[Prepared by request of Prof. S. F. Baird, for the London Exhibition, 1883.]

ALABAMA.

[Commissioners first appointed in 1871.]

Charles S. G. Doster, Prattville, Ala ..... 1871–1881+
D. B. Hundley, Courtland, Ala ..... 1871–1883+

ARIZONA.

[Commissioners first appointed in April, 1881.]

John J. Gosper, Prescott, Ariz ..... Apr., 1881–1883+
Richard Rule, Tombstone, Ariz ..... Apr., 1881–1883+
J. H. Taggart,[1] Yuma, Ariz ..... Apr., 1881–1883+

ARKANSAS.

[Commissioners first appointed January 25, 1876.]

James H. Hornibrook, Little Rock, Ark ..... Aug. 30, 1880–1883+
John E. Reardon, Little Rock, Ark ..... Aug. 30, 1880–1883+
H. H. Rottaken, Little Rock, Ark ..... Feb. 7, 1882–1883+

CALIFORNIA.

[Commissioners first appointed April 25, 1870.]

A. B. Dibble[2], Grass Valley, Cal ..... Apr., 1883–1884+
R. H. Buckingham, Washington, Cal ..... Apr., 1883–1884+
Joseph D. Redding, San Francisco, Cal ..... Dec., 1882–1883+
J. G. Woodbury, San Leandro, Cal., superintendent of fishery.

COLORADO.

[Commissioner first appointed Feb. 9, 1877.]

W. E. Sisty, Denver, Colo ..... Feb. 1881–1883.
E. V. Bogart, superintendent of hatchery.

CONNECTICUT.

[Commissioners first appointed September 11, 1866.]

Wm. M. Hudson, Hartford, Conn ..... Aug. 26, 1882–Aug. 26, 1886.
Robert G. Pike, Middletown, Conn ..... March 8, 1882–Mar. 8, 1886.
Geo. N. Woodruff, Sherman, Conn ..... Aug. 26, 1880–Aug. 26, 1884.

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[1] Business manager.
[2] Secretary and treasurer.
* The plus mark is affixed to years to indicate that the appointment was for an indefinite term, or for a term unknown to the compiler, and is still in force.

DELAWARE.

[Commissioner first appointed April 23, 1881.]

Enoch Moore, jr., Wilmington, Del.....Apr. 23, 1881–Apr. 23, 1883.

GEORGIA.

[Commissioner of Agriculture made *ex officio* Fish Commissioner 1876.]

J. T. Henderson,[3] Atlanta, Ga..... Aug. 26, 1882–Aug. 26, 1886[3]
Dr. H. H. Cary, La Grange, Ga., superintendent.

ILLINOIS.

[Commissioners first appointed May 20, 1875.]

N. K. Fairbank,[4] Chicago, Ill.....July 1, 1880–July 1, 1883.
S. P. Bartlett, Quincy, Ill.....July 1, 1881–July 1, 1884.
S. P. McDole, Aurora, Ill.....July 1, 1881–July 1, 1884.

INDIANA.

[Commissioner first appointed in Sept., 1881.]

Calvin Fletcher, Spencer, Ind.....1881 (?)–1883.

IOWA.

[Commissioners first appointed March 30, 1874.]

B. F. Shaw, Anamosa, Iowa.....Apr. 11, 1882–Apr. 11, 1884.
A. A. Mosher,[5] Spirit Lake, Iowa.....Oct., 1882–Oct., 1884.

KANSAS.

[Commissioner first appointed March 10, 1877.]

W. S. Gile, Vennago, Kans.....Mar. 10, 1883–Mar. 10, 1885.

KENTUCKY.

[Commissioners first appointed March 22, 1876.]

John B. Walker, Madisonville, Ky.....1878–1883+[6]
C. J. Walton, Munfordville, Ky.....1876–1883+
John A. Steele, Midway, Ky.....1876–1883+
W. C. Price, Danville, Ky.....1880–1884.
John H. Mallory, Bowling Green, Ky.....1882–1886.
W. Van Antwerp, Mount Sterling, Ky.....1880–1884.
J. M. Chambers, Independence, Ky.....1880–1884.
A. H. Goble, Catlettsburgh, Ky.....1880–1884.
P. H. Darby, Princeton, Ky.....1876–1883+
Wm. Griffith,[7] Louisville, Ky.....1876–1883+
Joseph Griffith, Louisville, Ky., superintendent.

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[3] Commissioner of Agriculture and *ex officio* Commissioner of Fisheries.
[4] President of Fish Commission.
[5] Assistant for Northwestern Iowa.
[6] The Commissioners are appointed by the governor for four years, and until their successors are appointed.
[7] President.

MAINE.

[Commissioners first appointed Jan. 1, 1867.]

Henry O. Stanley, Dixfield, Me.....Dec., 1879–Dec., 1883.
E. M. Stilwell, Bangor, Me.....Jan., 1883–Jan., 1886.

MARYLAND.

[Commissioners first appointed in April, 1874.]

Thomas Hughlett, Easton Md.....May, 1882–May, 1884.
George W. Delawder, Oakland, Md.....May, 1882–May, 1884.

MASSACHUSETTS.

[Commissioners first appointed May 3, 1865.]

E. A. Brackett,[8] Winchester, Mass.....June, 1879–June, 1884.
Asa French, South Braintree, Mass.....June, 1879–June, 1884.
F. W. Putnam, Cambridge, Mass.....June, 1879–June, 1884.

MICHIGAN.

[Commissioners first appointed April 25, 1873.]

Andrew J. Kellogg, Detroit, Mich.....Jan. 1, 1879–Jan. 1, 1885.
Dr. J. C. Parker, Grand Rapids, Mich.....Jan. 1, 1881–Jan. 1, 1887.
John H. Bissell, Detroit, Mich.....Jan. 1, 1883–Jan. 1, 1889.
W. O. Macks, Paris, Mich., superintendent.
Oren M. Chase, Detroit, Mich., superintendent.
Edward Chase, Detroit, Mich., assistant superintendent.
Herschel Whitaker, Detroit, Mich., secretary.

MINNESOTA.

[Commissioners first appointed in May, 1874.]

Daniel Cameron, La Crescent, Minn. (1st district).....Apr. 12, 1881–Apr. 12, 1884.
Wm. W. Sweney, M. D., Red Wing, Minn. (2d district)...Sept. 1, 1882–Sept. 1, 1885.
Robt. Ormsby Sweeny,[9] Saint Paul, Minn. (3d district)..Sept. 1, 1882–Sept. 1. 1885.
S. S. Watkins, Red Wing, Minn., superintendent.

MISSOURI.[10]

[Commissioners first appointed August 2, 1877.]

I. G. W. Steedman, M. D.,[11] Saint Louis, Mo.....June 15, 1881, May 17, 1883.
Col. John Reid, Lexington, Mo.....May 17, 1879–May 17, 1883.
Dr. John S. Logan, Saint Joseph, Mo.....May —, 1882–May 17, 1883.
Chas. George Eckardt, Saint Louis, Mo., superintendent.....Dec. 1, 1882–1883.

NEBRASKA.

[Commissioners first appointed June 2, 1879.]

William L. May, Fremont, Nebr.....June 1, 1880–June 1, 1883.
Robt. R. Livingston, Plattsmouth, Nebr.....June 1, 1881–June 1, 1884.
B. E. B. Kennedy, Omaha, Nebr.....June 1, 1882–June 1, 1885.

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[8] Executive officer of Board.
[9] Chairman of the Board.
[10] J. H. Steedman, secretary.
[11] Chairman and *ex-officio* treasurer.

NEVADA.

[Commissioner first appointed in 1877.]

Hubb. G. Parker, Carson City, Nev.....Mar. 5, 1881–Mar. 5, 1885.

NEW HAMPSHIRE.

[Commissioners first appointed Aug. 30, 1866.]

George W. Riddle, Manchester, N. H.....Dec. 6, 1882–Dec. 6, 1887.
Luther Hayes, Milton, N. H.....July 28, 1881–July 28, 1886.
Albina H. Powers, Grantham, N. H.....July 21, 1881–July 21, 1886.
E. B. Hodge, Plymouth, N. H., superintendent.

NEW JERSEY.

[Commissioners first appointed March 29, 1870.]

Theodore Morford, Newton, N. J.[12].....Apr. 3, 1878–1884+.
Richard S. Jenkins, Camden, N. J.[13]..... 1882–1884+.
William Wright.....Apr. –, 1883–1884+.

NEW YORK.

[Commissioners first appointed April 22, 1868.]

Robert B. Roosevelt, New York, N. Y.....1868–1883+.
E. M. Smith, Rochester, N. Y.....1872–1883+.
R. U. Sherman, New Hartford, N. Y.....1879–1883+.
Eugene G. Blackford, New York, N. Y.....1877–1883+.
Seth Green, Rochester, N. Y., superintendent.

NORTH CAROLINA.

[Superintendent of fisheries first appointed April 2, 1877.]

S. G. Worth, Raleigh, N. C.[14].....Feb. 1878–1883+.

OHIO.

[Commissioners first appointed May 3, 1873.]

Col. L. H. Harris,[15] Cincinnati, Ohio.....Apr. 15, 1881–1883+.
C. W. Bond,[16] Toledo, Ohio.....Apr. 15, 1881–1883+.
H. C. Post,[17] Sandusky, Ohio.....Apr. 15, 1881–1883+.
D. Y. Howell, Toledo, Ohio, superintendent.
Henry Douglass, Sandusky, superintendent.

OREGON.

[Commissioner first appointed Apr. 1, 1879.]

H. B. Ferguson,[18] Astoria, Oreg.....Apr. 1, 1879–Apr. 1, 1881.

[12] Chairman.
[13] Secretary and treasurer.
[14] E. M. Robinson, Raleigh, N. C., assistant.
[15] President.
[16] Treasurer.
[17] Secretary.
[18] Term expired Apr. 1, 1881. No information whether a new appointment has been made.

PENNSYLVANIA.[19]

[Commissioners first appointed April 15, 1866.]

James Duffy, Marietta, Pa.....June 8, 1881–June 8, 1884.
H. J. Reeder, Easton, Pa.....June 8, 1881–June 8, 1884.
Benj. L. Hewit, Hollidaysburg, Pa.....June 8, 1881–June 8, 1884.
John Hummel, Selin's Grove, Pa.....June 8, 1881–June 8, 1884.
G. M. Miller, Wilkes Barre, Pa.....June 8, 1881–June 8, 1884.
Robert Dalzell, Pittsburgh, Pa.....June 8, 1881–June 8, 1884.
John Creveling, Marietta, Pa., superintendent.
Seth Weeks, Corry, Pa., superintendent.

RHODE ISLAND.

[Commissioners first appointed in 1868.]

John H. Barden, Rockland, R. I.....June 15, 1880–June 15, 1883.
Henry T. Root, Providence, R. I.....Apr., 1883–1884+.
Col. Amos Sherman, Woonsocket, R. I.....Apr., 1883–1884+.

SOUTH CAROLINA.

[Superintendent of fisheries first appointed December 23, 1878.]

A. P. Butler,[20] Columbia, S. C.....Nov. 1, 1881–1883+.

C. J. Huske, Columbia, S. C., superintendent.

TENNESSEE.

[Commissioners first appointed January 14, 1877.]

W. W. McDowell, Memphis, Tenn.....Apr. 1875–1883+.
H. H. Sneed, Chattanooga, Tenn.....Feb. 1881–1883+.
Edward Hicks, Nashville, Tenn.....Aug. 1882–1883+.

TEXAS.

[Commissioner first appointed Sept. 26, 1879.]

John B. Lubbock, Austin, Tex.....Mar. 1883–1883+.

UTAH.[21]

[Action regarding fish culture dates from 1871.]

VERMONT.

[Commissioners first appointed in 1865.]

Hiram A. Cutting, Lunenburg, Vt.....Dec. 1, 1881–Dec. 1, 1886.
Herbert Brainerd, Saint Albans, Vt.....Dec. 1, 1881–Dec. 1, 1886.

VIRGINIA.

[Commissioner first appointed in April, 1874.]

Marshall McDonald,[22] Berryville, Va.....Jan. 1879–1883+

[19] Col. James Worrall, actuary.
[20] Commissioner of Agriculture and *ex-officio* Fish Commissioner.
[21] Since the death of Prof. J. L. Barfoot, curator of Deseret Museum, Salt Lake City, Utah, April, 1882, no new appointment has been made.
[22] Continues until a new appointment is made. The term of service, as defined by law, is two years. The Commissioner at present resides in Washington, D. C.

WASHINGTON.

[Commissioner first appointed November 9, 1877.]

Albert T. Stream,[23] North Cove, Wash.....Nov. 14, 1879–Jan. 9, 1882+.

WEST VIRGINIA.

[Commissioners first appointed June 1, 1877.]

Henry B. Miller, Wheeling, W. Va.....June 1, 1881–June 1, 1885.
C. S. White, Romney, W. Va.....June 1, 1881–June 1, 1885.
N. M. Lowry, Hinton, W. Va.....June 1, 1881–June 1, 1885.

WISCONSIN.[24]

[Commissioners first appointed March 20, 1874.]

Philo Dunning,[25] Madison, Wis.....Apr. 1, 1879–Apr. 1, 1885.
C. L. Valentine,[26] Janesville, Wis.....Apr. 1, 1881–Apr. 1, 1887.
J. V. Jones, Oshkosh, Wis.....Apr. 1, 1880–Apr. 1, 1886.
John F. Antisdel, Milwaukee, Wis.....Apr. 1, 1879–Apr. 1, 1885.
Mark Douglas, Melrose, Wis.....Apr. 1, 1881–Apr. 1, 1887.
Christopher Hutchinson, Beetown, Wis.....Apr. 1, 1879–Apr. 1, 1886.
James Nevin, Madison, superintendent.

WYOMING.

[Commissioners first appointed December 13, 1879.]

Dr. M. C. Barkwell, Cheyenne, Wyo.....Mar. 12, 1882–Mar. 12, 1884.
Otto Gramm, Laramie City, Wyo.....Mar. 12, 1882–Mar. 12, 1884.
E. W. Bennett, Warm Springs, Wyo.....Mar. 12, 1882–Mar. 12, 1884.
P. J. Downs, Evanston, Wyo.....Mar. 12, 1882–Mar. 12, 1884.
T. W. Quinn, Lander, Wyo.....Mar. 12, 1882–Mar. 12, 1884.
N. L. Andrews, Buffalo, Wyo.....Mar. 12, 1882–Mar. 12, 1884.

Dakota, Florida, Idaho, Louisiana, Mississippi, Montana, and New Mexico have not as yet had any fish commissioners.

INSPECTORS OF THE FISHERIES OF THE BRITISH PROVINCES.

CANADA.—W. F. Whitcher, Ottawa, Ont.
S. Wilmot, Superintendent, New Castle, Ont.
NEW BRUNSWICK.—W. H. Venning, St. Johns, N. B.
NOVA SCOTIA.—W. H. Rogers, Amherst, N. S.
PRINCE EDWARDS ISLAND.—J. H. Duvar, Alberton, P. E. I.
BRITISH COLUMBIA.—Alex. C. Anderson, Victoria, B. C.

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[23] Term expired January 9, 1882. No information whether a new appointment has been made.
[24] The governor of State *exofficio* Fish Commissioner.
[25] President.
[26] Secretary and treasurer.

6.—A LIST OF THE NAMES OF ALL PERSONS WHO HAVE BEEN APPOINTED COMMISSIONERS OF FISHERIES OF THE VARIOUS STATES OF THE UNITED STATES, WITH THEIR ADDRESSES AND THE DATES OF THEIR TERMS OF SERVICE.

By CHAS. W. SMILEY.

The preceding list of Commissioners is designed to include only such as are now in office. Those names, together with the names of all other persons who have acted as State commissioners and the names of superintendents, are here arranged in alphabetical order. Several years having elapsed since some of them retired from the work, the addresses may not all be correct for the present time. Those who are known to have died are marked "deceased," and their last official address is given. All were connected with the States indicated by the addresses, except in a very few cases, where the State by which the gentleman was appointed is indicated in parenthesis following the address. This list contains 237 names.

Akers, Col. George F., Nashville, Tenn.....1877–1882
Allen, Hon. W. C., Owingsville, Ky.....1876–1879
Anderson, G. A., Trenton, N. J.....1874–1883
Andrews, N. L., Buffalo, Wyo.....1882–1884
Antisdel, John F., Milwaukee, Wis.....1878–1885
Atkins, Charles G., Augusta, Me.....1867–1871
Atwood, N. E., Provincetown, Mass.....1857–1857
Austin, Gov. Horace, Saint Paul, Minn.....1874–1875
Bagley, John J., Detroit, Mich.....1873–1874
Ball, William B., Midlothian, Va.....1871–1874
Barkwell, M. C., M. D., Cheyenne, Wyo.....1882–1884
Barden, John H., Rockland, R. I.....1871–1883
Barfoot, Prof. J. L., Salt Lake City, Utah [deceased].....1880–1882
Barrett, Charles, Grafton, Vt.....1866–1870 and 1877–1881
Bartlett, S. P., Quincy, Ill.....1879–1884
Battle, Preston, R. P., Chapel Hill, N. C.....1878–1879
Bellows, Hon. Henry A., Concord, N. H.....1865–1869
Bennett, E. W., Warm Springs, Wyo.....1882–1884
Bill, James A., Lyme, Conn.....1871–1880
Bissell, John H., Detroit, Mich.....1883–1889
Blackford, Eugene G., Fulton Market and Brooklyn, N. Y.....1879–1883+
Bogart, E. V., Colo., superintendent of hatchery.....1882
Bond, C. W., Toledo, Ohio.....1881–1883+
Brackett, E. A., Winchester, Mass.....1869–1884
Brainerd, Herbert, Saint Albans, Vt.....1881–1885
Briggs, J. Smith, Kankakee, Ill.....1879–1880
Brownell, Charles H., Saint Joseph, Mo., superintendent.....1881–1882
Bruce, Hon. J. H., Lancaster, Ky.....1876–1879
Buckingham, B. H., Washington, Cal.....1883–1883+
Burt, Grover C., Mankato, Minn.....1876–1878
Butler, A. P., Columbia, S. C.....1879–1883
Cameron, Daniel, La Crescent, Minn.....1878–1884

Cary, H. H., Dr., Lagrange, Ga., superintendent 1880
Casey, Hon. James B., Covington, Ky 1876–1879
Chambers, Hon. James M., Independence, Ky 1880–1884
Chapman, R. A., Boston, Mass 1857
Chase, Oren M., Detroit, Mich., superintendent 1882
Clark, George, Ecorse, Mich 1873–1877
Coombs, Dr. S. W., Bowling Green, Ky 1876–1880
Cooper, George G., New York, N. Y 1869–1871
Creveling, John, Marietta, Pa., superintendent of hatchery 1882
Crockwell, Dr. J. D. M., Clear Lake, Utah, superintendent of fish farm 1881–1882
Cummings, Robert, Toledo, Ohio 1875–1881
Cutting, Hiram A., M. D., Lunenburg, Vt 1882–1885
Dalzell, Robert, Pittsburgh, Pa 1879–1884
Darby, P. H., Princeton, Ky ..... 1876–1883+
Davidson, Capt. Hunter, Md 1869–1872
Day, Dr. David, Saint Paul, Minn 1874
Delawder, Geo. W., Oakland, Md 1882–1884
Dexter, Newton, Providence, R. I 1870–1883
Dinkins, Hon. J. H., Austin, Tex 1879–1881
Doster, Charles S. G., Prattville, Ala ..... 1871–1883+
Douglass, Mark, Melrose, Wis 1878–1887
Dousman, H. F., Waterville, Wis 1876–1877
Downes, P. W., Denton, Md 1874–1877
Downs, P. J., Evanston, Wyo 1882–1884
Duffy, Hon. James, Marietta, Pa 1873–1884
Dunning, Philo, Madison, Wis 1879–1885
Edmunds, Dr. M. C., Weston, Vt 1871–1873
Ellzey, M. G., Blacksburg, Va 1875–1877
Evans, Maj. Jonathan, Fayetteville, N. C 1878–1879
Evans, Samuel B., Ottumwa, Iowa 1874–1876
Ewing, Henry Clay, Jefferson City, Mo 1880
Fairbank, N. K., Chicago, Ill 1875–1883
Farwell, J. D., Niles, Alameda County, Cal 1870–1882
Ferguson, Maj. T. B., Baltimore, Md. [Address changed to Washington, D. C.] 1874–1882
Ferguson, H. B., Astoria, Oreg 1879–1881
Field, Alfred R., Greenfield, Mass 1866–1869
Fifield, Andrew C., Enfield, N. H 1874–1876
Fish, N. H., Pine Bluffs, Ark. [deceased] 1876–1877
Fisher, John C., Coshocton, Ohio 1875–1881
Fletcher, Calvin Spencer, Ind 1881
Fletcher, Dr. Wm. W., Concord, N. H 1869–1874
Ford, Samuel H., Connecticut 1870
Foss, S. S., Rhode Island [deceased] 1868–1870
Foster, Nathan W., East Machias, Me 1867–1868
French, Asa, South Braintree, Mass 1873–1884
Gallup, Albert S., No. 8 E. 54 street, New York, N. Y. (Rhode Island) 1868
Garrard, Hon. T. T., Manchester, Ky 1876–1879
Gile, W. S., Venango, Kans 1883–1885
Goble, A. H., Catlettsburg, Ky 1880–1884
Golcher, William, Saint Paul, Minn 1876–1878
Goldsmith, Dr. M., Rutland, Vt 1871–1881
Gosper, John J., Prescott, Ariz ..... 1881–1883+
Gramm, Otto, Laramie City, Wyo 1882–1884
Green, Seth, Rochester, N Y., superintendent ..... 1868+

Griffith, Joseph, Louisville, Ky., superintendent.....1876-1883+
Griffith, William, Louisville, Ky.....1876-1883+
Hager, Albert D., Proctorsville, Vt. [Address changed to Chicago, Ill.]..1866-1870
Haines, Charles H., Waterloo, Iowa.....1874-1876
Harris, J. W., Lewisburg, W. Va.....1877-1878
Harris, Col. L. A., Cincinnati, Ohio.....1878-1883+
Hatch, Thomas E., Keene, N. H.....1869-1874
Hayes, Luther, Milton, N. H.....1876-1886
Henderson, Hon. J. T., Atlanta, Ga.....1879-1886
Hewitt, Benjamin L., Hollidaysburg, Pa.....1873-1884
Hicks, Edward D., Nashville, Tenn.....1882-1883+
Hodge, E. B., Plymouth, N. H., superintendent of hatchery.....1878-1879
Holt, Col. S. M., Haw River, N. C.....1878-1879
Hooper, Moses, Oshkosh, Wis.....1878
Hornibrook, James, Little Rock, Ark.....1880-1883+
Howell, Dr. B. P., Woodbury, N. J. [deceased October 10, 1882].....1870-1882
Howell, D. Y., Toledo, Ohio, superintendent.....1882
Hoy, Dr. P. R., Racine, Wis.....1874-1878
Hudson, William M., Hartford, Conn.....1870-1886
Hughlett, Thomas, Easton, Md.....1878-1884
Hummel, John, Selin's Grove, Pa.....1879-1884
Hundley, D. B., Courtland, Ala.....1871-1883+
Huske, C. J., Richland, S. C., superintendent.....1880-1883+
Hussey, John, Lockland, Ohio.....1873-1874
Hutchinson, Christopher, Beetown, Wis.....1878-1886
Janes, Thomas P., Atlanta, Ga.....1876-1879
Jenkins, Richard S., Camden, N. J.....1882-1883
Jerome, George H., Niles, Mich.....1873-1878
Jones, James V., Oshkosh, Wis.....1879-1886
Kaley, H. S., Red Cloud, Nebr.....1879-1882
Kellogg, Andrew J., Detroit, Mich.....1874-1885
Kennedy, B. E. B., Omaha, Nebr.....1882-1885
Kew, Prof. W. C., Raleigh, N. C.....1878-1879
Klippart, John H., Columbus, Ohio [deceased].....1873-1877
Laffoon, Polk, Madisonville, Ky.....1876-1877
Latham, A. W., Excelsior, Minn.....1874-1875
Leinenweber, C., Astoria, Oreg.....1879
Livingston, Dr. Robt. R., Plattsmouth, Nebr.....1879-1884
Logan, Dr. John S., Saint Joseph, Mo.....1882-1883
Long, Hon. D. B., Ellsworth, Kans.....1877-1883
Lowry, N. M., Hinton, W. Va.....1879-1885
Lubbock, John B., Austin, Tex.....1883-1883+
Luddington, Gov. Harrison, Milwaukee, Wis.....1876-1877
Lyman, Theodore, Brookline, Mass.....1865-1881
McDole, S. P., Aurora, Ill.....1881-1884
McDonald, Col. M., Lexington, Va. [Address changed to Washington, D. C.].....1879-1883
McDowell, Judge W. W., Memphis, Tenn.....1877-1883+
Macks, W. O., Paris, Mich., superintendent.....1882-1883+
McGehee, Munford, Raleigh, N. C.....1880
Mallory, John H., Bowling Green, Ky.....1882-1886
May, William L., Fremont, Nebr.....1879-1883
Miller, Eli R., Richland, Mich.....1875-1883
Miller, G. M., Wilkes Barre, Pa.....1879-1884
Miller, Henry B., Wheeling, W. Va.....1877-1885

Moore, Enoch jr., Wilmington, Del 1881–1883
Morford, Theodore, Newton, N. J 1878–1883
Moseley, A., Richmond, Va 1875–1877
Mosher, A. A., Spirit Lake, Iowa 1882–1884
Nevins, James, Wisconsin, superintendent 1882
Noyes, Oliver H., Henniker, N. H 1874–1876
Palmer, Alfred, Boscobel, Wis 1874–1877
Parker, Hubb. G., Carson City, Nev 1877–1885
Parker, Dr. Joel C., Grand Rapids, Mich 1877–1887
Pearce, E. D., Providence, R. I 1868
Pearce, Gen. N. B., Osage Mills, Ark 1876-1881
Pike, Robert G., Middletonn, Conn 1870–1886
Polk, L. L. Raleigh, N. C. [deceased May 26, 1880] 1877–1880
Portman, James G., Pokagan, Mich 1879–1881
Post, Henry C., Sandusky, Ohio ..... 1881–1883+
Potter, Emery D., Toledo, Ohio 1875–1881
Powers, Albina H., Grantham, N. H 1876–1886
Pratt, Dr. W. A., Elgin, Ill 1875–1879
Price, W. C., Danville, Ky 1880–1884
Putnam, F. W., Cambridge, Mass 1879–1884
Quinn, F. W., Lander, Wyo 1882–1884
Rankin, James, Old Saybrook, Conn 1868–1869
Reardon, John E., Little Rock, Ark ..... 1880–1883+
Redding, B. B., San Francisco, Cal. [deceased, 1882] 1870–1880
Redding, Joseph D., San Francisco, Cal ..... 1882–1883+
Reed, Alfred A., Rhode Island 1868–1883
Reed, Alfred A., Massachusetts [deceased] 1865–1866
Reed, Alfred A., jr., Providence, R. I 1871–1883
Reeder, Hon. Howard J., Easton, Pa 1873–1884
Reid, Col. John, Lexington, Mo 1877–1883
Riddle, George W., Manchester, N. H 1882–1887
Robertson, R. R., Austin, Tex 1881–1883
Robertson, Dr. W. B., Lynchburg, Va 1875–1877
Robinson, Henry C., Hartford, Conn 1866–1869
Rockwood, A. F., Salt Lake City, Utah 1871–1879
Root, Henry J., Providence, R. I ..... 1883–1883+
Rosevelt, Robert B., New York, N. Y ..... 1868–1883+
Rottaken, H. H., Little Rock, Ark ..... 1882–1883+
Rule, Richard, Tombstone, Ariz ..... 1881–1883+
Rumsey, Capt. Henry B., Laramie City, Wyo 1879–1881
Russell, F. W., Hartford, Conn 1866–1869
Sanborn, W. A., Weirs, N. H 1865–1874
Seymour, Horatio, Utica, N. Y 1868–1878
Shaw, Benjamin F., Anamosa, Iowa 1874–1884
Sherman, Col. Amos, Woonsocket, R. I ..... 1883–1883+
Sherman, Richard U., New Hartford, N. Y ..... 1879–1883+
Shortwell, J. R., Rahway, N. J 1873–1877
Sisty, Wilson E., Denver, Colo 1879–1883
Slack, Dr. J. H., Bloomsbury, N. J. [deceased] 1870–1873
Smith, Edward M., Rochester, N. Y ..... 1872–1883+
Smith, Everett, Portland, Me 1879–1882
Smith, Gov. William E., Madison, Wis 1878–1880
Sneed, Hon. H. H., Chattanooga, Tenn ..... 1880–1883+
Spalding, Dr. Edward, Nashua, N. H 1881–1882
Stanley, Henry O., Dixfield, Me 1872–1883

Steedman, Dr. Isaiah G. W., Saint Louis, Mo 1879–1883
Steele, Hon. John A., Midway, Ky ..... 1876–1883+
Steelman, J. R., Little Rock, Ark. [deceased] 1876–1877
Sterling, Dr. E., Cleveland, Ohio 1873–1874
Stilwell, E. M., Bangor, Me 1872–1886
Stream, Albert T., North Cove, Wash 1877–1882
Sweeny, Robert Ormsby, Saint Paul, Minn 1875–1884
Sweney, William M., M. D., Red Wing, Minn 1883–1884
Sweney, William W., M. D., Red Wing, Minn. [deceased Aug. 12] 1878–1882
Taggart, J. H., Yuma, Ariz ..... 1881–1883+
Talbot, Thomas, North Bellerica, Mass 1870–1872
Thomas, Pack, Louisville, Ky 1876
Timmons, William E., Snow Hill, Md 1873
Tompkins, C. H., New York, N. Y. (formerly Rhode Island) 1868
Traylor, W. W., San Francisco, Cal 1882–1883
Trespan, Capt. J. R., Tarborough, N. C 1878–1879
Trockmorton, S. R., San Francisco, Cal 1870–1883
Turley, Hon. W. T., Knoxville, Tenn 1877–1880
Tyler, Robert, Montgomery, Ala 1872–1880
Valentine, C. L., Janesville, Wis 1879–1887
Van Antwerp, Dr. William, Mount Sterling, Ky 1880–1884
Vance, Hon. Z. B., Charlotte, N. C 1878–1879
Wadleigh, John S., Laconia, N. H 1874–1876
Walker, John B., Madisonville, Ky. [moved and address lost] ..... 1878–1883+
Wall, Asa, Winchester, Va 1871–1874
Walton, Hon. C. J., Munfordville, Ky ..... 1876–1883+
Watkins, S. S., Minn., superintendent 1882
Webber, Col. Samuel, Manchester, N. H 1876–1881
Weeks, Seth, Corry, Pa., superintendent hatchery 1882
Welch, William, Madison, Wis 1874–1878
Welsher, H. W., Madison, Wis 1878–1881
Welsher, W. A., Madison, Wis 1878
Wheatland, Henry, Salem, Mass 1857
White, Christian S., Romney, W. Va 1877–1885
Wilson, P. M., Raleigh, N. C 1880
Woodbury, John G., San Leandro, Cal., superintendent of fishery ..... 1883+
Woodruff, George N., Sherman, Conn 1880–1884
Woodson, Hon. Silas, Saint Joseph, Mo 1879–1883
Woodward, Henry, Middletown, Conn 1868–1869
Worrall, James, Harrisburg, Pa 1870–1872
Worth, S. G., Morgantown, N. C ..... 1878–1883+
Wright, William, Newark, N. J ..... 1883–1883+
Dibble, A. B., Grass Valley, Cal 1883–1884
Douglass, Henry, Sandusky, Ohio, superintendent 1883
Eckardt, Chas. George, St. Louis, Mo., superintendent 1883

7.—GROWTH AND PROTECTION OF CARP FROM TURTLES, ETC.

By EDWARD STABLER.

[From a letter to Rudolph Hessel.]

Professor Baird and yourself have afforded me so much gratification that I can do no less that again thank you for the pleasure you have

been the means of conferring, for I can now at my pleasure take a 5-pound carp out of my pond, within 300 to 400 yards of my own door.

My pond contains some three-quarters of an acre. The supply of water is brought from the outside through a 4-inch pipe, which near the outlet or draining trough connects with a perpendicular iron pipe, at the top of which the water is discharged. During floods it is stopped in the outside ditch, and passes around the pond. The pond is lined with boards for 100 yards or more, making it proof against rats and crayfish.

The carp weighed from one-half to three-quarters of a pound when they were received, April 1, 1882. I fed them pretty regularly last summer, and they grew wonderfully. They now come up of themselves to be fed. Last September I took three or four weighing quite 3 pounds apiece, which I returned to the water; and a few days ago, June 28, 1883, I took out a 5-pounder, to show how they increase in size, but did not kill this one either. It was 20 inches long and 8 inches broad, and appeared to have from a gill to half a pint of spawn in it. I do not think that those received spawned last season, as I have seen no young fish as yet.

In a year, if I like, I shall have all the sport desired in the way of fishing. I now have plenty of shooting, in cutting off turtle's heads with explosive shells. I have killed several dozen in this way, and some very large ones, say 12 inches in diameter. I learned from an acquaintance who has some large carp that in draining his pond he found the tails of some of his large fish bitten off, no doubt by large turtles, which were seen there.

On account of my frequent shooting at the pond, the remaining turtles have become almost as wild as wild turkeys, scarcely showing more than the nose above the water, and for a moment only; but it is enough if I can see the head a few seconds, as the shell explodes on striking the water and kills them, and in about thirty-six hours they float on the surface and can be taken out.

I was much surprised recently, when in setting a hook with meat-bait to catch the turtles—they are frequently taken in this way—I caught several eels of about 2 feet or over in length. They could only have entered through the ingress pipe three or four years ago, when of a finger's length, and through wire gauze having a one-fourth inch mesh. They have grown almost as rapidly as the carp.

As soon as my fish have done spawning, I will let off the water and clean out turtles, eels, snakes, and all. Now that I have the fish and am keeping them so successfully I do not intend that depredators shall have the benefit.

Professor Baird has benefited a very large number by the distribution of these and other valuable fish, and he deserves, and doubtless receives, the thanks of hundreds, if not of thousands, far and near.

SANDY SPRING, MD., *June* 31, 1883.

Vol. III, No. 9. Washington, D. C. Aug. 31, 1883.

8.—A LIST OF THE BLANK FORMS, CIRCULARS, AND MINOR PUBLICATIONS OF THE UNITED STATES FISH COMMISSION, FROM ITS ORGANIZATION IN 1871 TO AUGUST 1, 1883.

By CHAS. W. SMILEY and CHAS. W. SCUDDER.

1. [Serial mark $E\frac{B}{2}$.] Circular-letter addressed to fishermen living near Lake Michigan, announcing that fishes with metallic tags had been liberated at twenty points, and asking for information about their subsequent capture. 5 questions. 1871. 1 page. 20.5 by 25.5cm.

2, 3. (Transferred to list of important publications.)*

4. [Serial mark $E\frac{B}{1}$.] Circular-letter inviting information concerning food-fishes. 1872. 1 page. 20 by 25.5cm.

5, 6, 7, 8, 9, 10. (Transferred to list of important publications.)

11. [Serial mark $E\frac{C}{2}$.] Blank for statistics of fishing vessels, particulars of vessel, crew, and occupation. Also specimen table. Ruled in 11 columns. 1875. 2 pp. 32.5 by 42cm.

12. [Serial mark 10, $E\frac{C}{1}$.] Circular-letter to collectors of customs. To accompany No. 11. Statistics of the fishery marine. On reverse is same specimen table as in No. 11. 1875. 2 pp. 20.5 by 33cm.

13, 14, 15. (Transferred to list of important publications.)

16. [Serial mark $E\frac{B}{6}$.] Statistics of the mackerel fisheries, &c. Circular letter asking replies to questions. 1877. 1 p. 21 by 33cm.

17. [Serial mark $E\frac{B}{7}$.] Statistics of the cod fisheries, &c. Circular-letter soliciting information. 1877. 1 p. 21 by 33cm.

18. [Serial mark $E\frac{B}{8}$.] Statistics of the mullet fisheries, &c. Circular-letter for southern coast, soliciting information. 1877. 1 p. 21 by 32.5cm.

19. (Transferred to list of important publications.)

20. Serial mark $\frac{C}{101}\frac{C}{3}$.] Statistics of the fish trade, New York market. Dealers' statement. Blanks for pounds of thirty leading kinds of food-fish, received daily. 1877. 32 columns, 2 pp. 33 by 42cm.

21. [Serial mark $E\frac{C}{4}$.] Statistics of the whale fisheries. Blanks for the number and kind of vessels, tonnage, and yield of oil. 1877. 13 columns, 2 pp. 21 by 33cm.

22. [Serial mark A.] Record of hatching operations. Blank for recording temperatures, wind, tide, fish and eggs taken. 1877. 22 columns, 2 pp. 33 by 42cm.

23. [Serial mark B.] Record of operations of State Fsh Commissioners in hatching and distributing young fish. Blanks for recording eggs received, time, condition, loss, hatching, distributing, &c. 1877. 18 columns, 2 pp., each 33 by 42cm.

24. [Serial mark C.] Record of distribution of fish. Blanks for recording date, number, place, stream, &c. 1877. 12 columns, 1 p. 33 by 42cm.

25. Record of collection of eggs. Blank for nature of fishery, seine, haul, number of fish taken, eggs impregnated, &c. 1877. 24 items, 1 p. 10 by 21cm.

26, 27, 28, 29, 30. (Transferred to list of important publications.)

31. [Serial mark $E\frac{C}{4}$.] Statistics of the fresh-fish trade, New England markets. Dealers' statements. Blanks for pounds of 36 different kinds of fish for each day during the month. 1878. 38 columns, 2 pp. 33 by 42cm.

32. (Transferred to list of important publications.)

* See page 1, U. S. F. C. Bulletin, 1883.

33. Circular-letter of acknowledgment of receipt of returns on the mackerel fishery. February 8, 1879. 1 p. 13 by 20cm.

34. Circular-letter acknowledging replies to menhaden and cod circulars, and asking full information concerning the mackerel. December, 1878. 1 p. 20 by 25cm.

35. Record of ocean temperatures. Blank for recording time, temperatures, winds, weather, and movements of fishes. 1878. 20 columns, 1 p. 35.5 by 43cm.

36. Application for fish. 13 items. April 12, 1879. 1 p. 11.5 by 17cm.

37, 38. (Transferred to list of important publications.)

39. Record of dredging stations. Blanks for observations—date, locality, tide, sky, depth of water, temperature, air, wind, currents, &c. September, 1879. 31 columns, 2 pp. 35.5 by 43cm.

40. Circular-letter to coast-towns, inviting co-operation. To accompany No. 41. July, 1879. 1 p. 20 by 26cm.

41. Returns of circular inviting co-operation. 6 questions concerning fishing-vessels, apparatus, fishermen, and fish-markets. July 1, 1879. 1 p. 20.5 by 33cm.

42. Circular-letter relating to the fish trade and consumption of fish. July, 1879. 1 p. 20 by 26cm.

43, 44. (Transferred to list of important publications.)

45. Statistics of fishery marine. Note-book for description of vessel, crew, fishery, stock, profits, catch and sale of fish. September, 1879. 1 p. 11 by 20cm. Roan vol. 60 p. each.

46. Statistics of the fishing-vessels of the United States. Second edition of No. 11, revised. Circular form of No. 45. September, 1879. 34 columns. 2 pp. 35 by 43cm.

47. Letter to persons interested in fish-culture, and calling for information. Hektograph. October 20, 1879. 1 p. 20 by 25cm.

48. Fish-cultural returns. Questions upon fish-culture, hatcheries, stocking public waters, articles published, &c. November 6, 1879. 15 questions. 1 p. 20 by 33cm.

49. Circular-letter to practical fish-culturists. October, 1879. 1 p. 20 by 25cm.

50. [Serial mark 3179.] Property receipts. Blank for number, articles, condition, value, remarks. 6 columns, 1 p. Filing blank on reverse. 20 by 25cm.

51. Coast-town index. Blank for fishing statistics of the coast-towns for use in compilation of returns of No. 41. October, 1879. 8 columns, 1 p. 20 by 32cm.

52. Letter to Rhode Island postmasters who failed to answer questions on fish trade and consumption of fish. Hektograph. November 26, 1879. 5 questions. 1 p. 19.5 by 24.5cm.

53. [Serial mark 7-119.] Questions concerning fishing towns, periods, distance up the river, tide-water, obstruction, kinds of fish and apparatus used. October, 1879. 8 questions. 1 p. 21 by 35cm.

54. [Serial mark 7-151.] Circular-letter of the Postmaster-General to postmasters. October, 1879. 1 p. 20 by 26cm.

55. (Transferred to list of important publications.)

56. Property record. Blanks for date, number, name, application, description, maker, where used, cost, and remarks. October, 1879. 9 columns, 1 p. 35.5 by 45cm.

57. Blank for measurements of fishes. Issued 1875 or 1876. 8 columns, 2 pp. 21.5 by 35cm.

58. Questions relating to the menhaden. Movements, quantity, food, eggs, fatality, vessels, oil made, price, &c. Hektograph. November, 1879. 2 pp. 19.5 by 32.5cm.

59. Letter to manufacturers of menhaden oil. To accompany No. 58. Hektograph. November 18, 1879. 1 p. 20 by 25cm.

60. Measurements of fishes. Reprint of No. 57, revised. December, 1879. 8 columns, 2 pp. 21.5 by 35cm.

61. Record of observations at hatching-stations. Blank for recording date, temperature, wind, sky, and tide. December, 1879. 26 columns, 1 p. 40 by 51.5cm.

62. Record of hatching operations. Reprint of No. 22. December, 1879. 20 columns, 1 p. 40 by 51.5cm.

63. Record of observations of State Fish Commissioners in hatching and distributing young fish. Reprint of No. 23. December, 1879. 18 columns, 2 pp. 35.5 by 44cm.

64. Record of distribution of fish. Reprint of No. 24. 18 columns, December, 1879. 1 p. 41 by 52cm.

65. Record of collection of eggs. Blank for nature of fishery, description of seine, haul, number of fish taken and stripped, eggs impregnated, &c. 24 items. 1 p. 10 by 21cm. Roan vol. 88 p. each.

66. Circular-letter and questions upon the natural production, artificial propagation, and commercial value of oysters. 15 questions. Hektograph. January, 1880. 2 p. 19.5 by 32cm.

67. [Serial mark 7-217.] Blank record book of river fisheries; first page, with name of fishery, owner, operator, &c.; succeeding pages blank for record of catch, value, and disposition of shad, and other fish, February, 1880. 1 p. 10.5 by 21.5cm. Roan vol. 216, pp. each.

68. Circular-letter asking parties to keep record of river fisheries. To accompany No. 67. Hektograph. February, 1880. 1 p. 20 by 25cm.

69. Blank for record of ocean temperature, movements of fish, &c., for mackerel and menhaden vessels. 25 columns. February, 1880. 2 p. 35.5 by 43cm.

70. Circular-letter and questions concerning the oyster industry of Maryland. 15 questions. Hektograph. February, 1880. 2 forms, 1 p. each. 19.5 by 25, and 19.5 by 32cm.

71. Circular-letter relating to fish-trade, sale, and consumption of fish. 5 questions. Hektograph. December 1, 1879. 1 p. 19.5 by 25cm.

72. Nine questions to supplement circular 41. Hektograph. December, 1879. 1 p. 19.5 by 32 cm.

73. Circular-letter and questions concerning the use of fish-guano. 5 questions. Hektograph. December 17, 1879. 1 p. 19.5 by 25cm.

74. Circular-letter and questions concerning post-offices within three miles of the coast. 6 questions. Hektograph. January, 1880. 1 p. 20 by 32cm.

75. Circular-letter and blank for determining post-offices within three miles of the coast. Hektograph. February 7, 1880. 1 p. 20 by 32cm.

76. [Serial mark 7-028.] Blank for voucher. Expenses for the tenth census of the United States. Statistics of the fisheries. June, 1880. 1 p. 20 by 25.5cm.

77. Circular-letter asking for lists of vessels engaged in the menhaden fishery. Hektograph. February 5. 1 p. 19.5 by 25cm.

77 A. Blank for list of vessels engaged in the menhaden fishery. 7 columns. To accompany No. 77. Hektograph. February 5, 1880. 1 p. 19.5 by 32.5cm.

77 B. Note of acknowledgment of the receipt of 77 A. Hektograph. February 5, 1880. 1 p. 19.5 by 25cm.

78. Shipping record of the United States Fish Commission to the International Fishery Exhibition at Berlin, February, 1880. 18 columns, 1 p. 24.5 by 35cm. Bound vol. pp. 200±.

79. Circular-letter to houses proposing to participate in the Berlin Fishery Exhibition. Hektograph. February 24, 1880. 3 pp. 20 by 25cm.

80. [Serial mark $\frac{A}{1}$.] Circular letter of Barnet Phillips to railroads terminating in New York concerning fish transportation. February, 1880. 1 p. 12.5 by 20cm.

81. [Serial mark $\frac{A}{2}$.] Blank for information upon transportation of fish. To accompany No 80. 11 questions. February, 1880. 20.5 p. 1 by 25.5cm.

82. [Serial mark $\frac{A}{3}$.] Blank for information concerning fish as food, its transportation, and use as fertilizer. 17 questions. 1 p. 11 by 23cm.

83. Circular-letter requesting additional information in regard to the oyster industries. Hektograph. March, 1880. 1 p. 19.5 by 25.5cm.

84. Blank for statistics of oyster vessels, moral and social condition of oyster men. To accompany No. 83. Hektograph. March, 1880. 1 p. 20.5 by 32cm.

85. Circular-letter and questions concerning the use of oysters, clams, scollops, capital, wages, and employés. 8 questions. March, 1880. 1 p. 11.5 by 23cm.

86. Circular-letter and questions on oysters, inquiring concerning direction and extent of transportation. 9 questions. March, 1880. 1 p. 11.5 by 23cm.

87. [Serial mark 7–276.] Circular-letter and questions by Charles G. Atkins, concerning the river-fisheries of Maine, especially salmon, alewives, and smelts. 10 questions. April, 1880. 1 p. 20.5 by 25.5cm.

88. Circular-letter concerning menhaden on the coast of Maine in the summer of 1880, with the request that fishing vessels record temperatures. Hektograph. March 16, 1880. 2 pp. 20 by 25.5cm.

89. Circular-letter to Susquehanna River shad fishermen, asking a record of the year's catch on blank No. 67. Hektograph. March 27, 1880. 1 p. 19.5 by 25.

89 A. Blank for application for No. 67. To accompany No. 89. March 27, 1880. 1 p. 19.5 by 25cm.

90. Blank for geographical catalogue of fish dealers. 3 columns. Hektograph. November, 1879. 1 p. 20 by 31.5cm.

91. Circular-letter to collectors of customs, requesting information concerning fishing licenses issued in their districts. Hektograph. March 16, 1880. 1 p. 20 by 25cm.

92. Questions to collectors of customs concerning the fishing licenses issued in their districts. 9 questions. March, 1880. 1 p. 20 by 31.5cm.

93. Blank for compilation of commerce and navigation statistics. 29 columns. December, 1879. 1 p. 48 by 61cm.

94. Circular-letter to light-house keepers asking the condition of their thermometers and stationery. 6 questions. Hektograph. April 1, 1880. 1 p. 20 by 31.5cm.

95. Circular-letter to applicants for copies of the United States Fish Commissioners' Report. 1878? 1 p. 13 by 20.5cm.

96. Blank for the statistics of the river fisheries. Circular form of No. 67, with additions. 13 questions. May, 1880. 1 p. 20 by 35.5cm.

97. Blank for information concerning the shipment of fish. 6 columns. May, 1880. 1 p. 20 by 25.5cm.

98. Circular-letter to menhaden fishing firms announcing blanks and thermometers forwarded. Hektograph. April 3, 1880. 1 p. 20.5 by 32cm.

99. Circular-letter to the secretaries of states asking the date of origin of the State Commissions. Inclosing No. 100. Hektograph. April 7, 1880. 1 p. 19.5 by 25cm.

100. Inquiry concerning State Commissioners, their organization, reports, date of appointment, and amounts of appropriation. To accompany No. 99. Hektograph. April 7, 1880. 1 p. 20.5 by 31.5cm.

101. Circular-letter and questions upon the manufacture of salt on the Pacific coast. 12 questions. Hektograph. May, 1880. 1 p. 19.5 by 32.5cm.

102. Circular-letter to men engaged in the Delaware River fisheries. To accompany No. 96. Hektograph. May, 1880. 1 p. 20.5 by 32cm.

103. Blank for recording application for eggs and young fish. 13 columns per folio. 1 p. 21.5 by 33cm. Bound vol. pp. 300±.

104. Blank for statements of the oyster industries in Virginia. To accompany No. 105. 5 questions. Hektograph. May 25, 1880. 1 p. 29.5 by 32cm.

105. Circular-letter to Virginia oystermen, requesting them to fill blank No. 104. May 25, 1880. Hektograph. 1 p. 25 by 32cm.

106. Circular-letter to collectors of customs acknowledging receipt of No. 92, asking them to furnish the detailed statistics therein indicated. Hektograph. May 28, 1880. 1 p. 19.5 by 25cm.

107. Blank for the list of post-offices in the lake and sea-coast counties, located within 3 miles of the coast. 3 columns. Hektograph. June, 1880. 1 p. 20 by 32cm.

108. Circular-letter to postmasters located within 3 miles of the coast, inquiring whether there are any fishermen in their vicinity. To accompany No. 41. Hektograph. June, 1880. 1 p. 16 by 19.5cm.

109. Circular-letter to light-house keepers, announcing supplies sent, with blank form of receipt to be returned. Hektograph. June 12, 1880. 1 p. 20 by 32cm.

110. Circular-letter to light-house keepers, inclosing addressed return envelopes. Hektograph. July 2, 1880. 1 p. 19.5 by 25cm.

111. Blank for compiling a summary of goods exported; fish, oil, whale-bone, and oysters. 4 columns. Hektograph. July, 1880. 1 p. 20 by 32cm.

112. Blank for summary of goods imported. 4 columns. Hektograph. July, 1880. 1 p. 20 by 32cm.

113. Blank for dried and smoked fish and spermaceti and whale-oil exported by countries. Hektograph. July, 1880. 1 p. 20 by 32cm.

114. Circular-letter to newspaper publishers, asking for copies to complete the files. Hektograph. July 2, 1880. 1 p. 19.5 by 25.5cm.

115. Blank for compiling fish, oil, whale-bone, and candles exported by countries. Hektograph. July, 1880. 1 p. 26.5 by 31.5cm.

116. Book for recording temperature, depth of water, currents, and nature of bottom. 1878. 1 p. 10 by 20cm. Roan vol. 44 pp. each.

117. Blank for acknowledging receipts of letters. 1878. 1 p. 12 by 20cm.

118. Blank for acknowledging receipts of letters. January 29, 1879. 1 p. 12.5 by 20.5cm.

119. Blank for acknowledging receipt of letters. 1878? 1 p. 20.5 by 25.5cm.

120. Circular-letter asking what number of eggs are desired by each State Commissioner. 1878? 1 p. 19 by 24.5cm.

121. Blank for compiling the names of fishermen. Hektograph. May, 1880. 1 p. 20.5 by 31.5cm.

122. List of references of P. H. Alexander & Co. Berlin. Hektograph. August, 1880. 1p. 20.5 by 26cm.

123. Circular-letter to International Fishery Exhibition Medalists. Hektograph. August 7, 1880. 1 p. 20.5 by 26cm.

124. Circular-letter to exhibitors at the International Fishery Exhibition to whom honorary mention was awarded. Hektograph. August 7, 1880. 1 p. 20.5 by 26cm.

125. Blank for exports from the cod fisheries of Massachusetts, by countries, for 1765–'75. Hektograph. August, 1880. 1 p. 20 by 31.5cm.

126. Blank for exports from the cod fisheries of Massachusetts, by countries, for 1786–'89. Hektograph. August, 1880. 1 p. 20 by 31.5cm.

127. Circular-letter to postmasters in coast counties asking the distance from tide-water and the number of fishermen. Hektograph. August, 1880. 1 p. 20 by 31.5cm.

128. Inquiry concerning fishing vessels, traps, fishermen, and markets. 7 questions. Hektograph. August, 1880. 1 p. 20.5 by 32.5cm.

129. Circular-letter inviting co-operation in coast towns. Modification of No. 40. To accompany No. 128. August, 1880. 1 p. 20.5 by 26cm.

130. Circular-letter to marine insurance companies inquiring to what extent they have engaged in insuring fishing vessels. 5 questions. June, 1880. 1 p. 20 by 31.5cm.

131. River compilation blank for tabulating circular 48. 4 columns. Hektograph. 1 p. 20.5 by 31.5cm.

132. Blank for tabulating distribution of California salmon. 7 columns. Hektograph. 1 p. 20.5 by 32.5cm.

133. Blank for tabulating distribution of Schoodic salmon. 8 columns. Hektograph. 1 p. 20 by 32cm.

134. Blank for tabulating distribution of shad. 7 columns. Hektograph. 1 p. 20 by 32.5cm.

135. Circular-letter to carp applicants, announcing a trip of messenger. October, 1879. 1 p. 20 by 25cm.

136. Circular-letter to carp applicants, announcing a trip of messenger. 1880. 2 p. 20 by 26.5cm.

137. Directions for making temperature observations of the ocean at coast stations. Circular-letter. August 10, 1878. 1 p. 14 by 21.5cm.

138. Circular-letter to railroad corporations, inclosing copies of No. 140 and thanking them for transporting young fish. April 12, 1879. 2 p. 13 by 20.5cm.

139. Blank application for carp. 12 questions. 1 p. 11.4 by 17.4cm.

140. Orders issued by railroad companies to employés concerning transportation of live fish in baggage cars. 1875–'79. 1 p. each, 11.5 by 19cm. Roan vol. 108 pp.

141. Blank for voucher. Expenses of propagation of food-fishes. 1879–'80. October 16, 1879. 1 p. 19.5 by 25.5cm.

142. Blank for geographical catalogue of fish dealers. 3 columns. Hektograph. November, 1879. 1 p. 20 by 31.5cm.

143. Circular-letter to superintendent of railroads forwarding copies of No. 140. March 26, 1880. 1 p. 20.5 by 25.5cm.

144. Circular-letter acknowledging application for carp, announcing that application will be filled later. April 1, 1880. 1 p. 20.5 by 25.5cm.

145. Blank for application for carp. 9 questions. 2 pp. 20.5 by 25.5cm.

146. Circular-letter to railroad auditors, concerning payment of Army quartermasters' transportation order. June 1880. 1 p. 20.5 by 2.6cm.

147. Circular-letter inquiring how many eggs of salmonidæ each State Commission desires. November 27, 1880. 1 p. 20 by 25.5cm.

148. Circular-letter to carp applicants, announcing the seasons' distribution finished, and giving directions concerning ponds. 1 p. 20 by 25.5cm.

149. Circular-letter to carp applicants, announcing supply sent to central point for distribution, and giving instructions how to transport and feed them. 1880. 1 p. 19.5 by 25.5cm.

150. Circular-memorandum to carp applicants; instruction for preparing pond. 1 p. 19.5 by 20cm.

151. Circular-letter of United States Fish Commission messenger to carp applicants, announcing carp in readiness to deliver. 1 p. 20 by 27cm.

152. Circular-letter to carp applicants, stating when distribution will occur, and giving directions how to prepare pond and receive fish. 1 p. 20 by 25.5cm.

153. Orders issued by railroad companies concerning transportation of live fish in baggage-cars. March, 1880. 1 p. 10.5 by 18.5cm. Roan vol., 108 pp. each.

154. Circular-letter to carp applicants, stating that owing to late appropriation applications cannot be filled till September or October, 1880. 1 p. 20 by 27cm.

155. Circular-letter to carp applicants, stating that applications will be filled in October and November, explaining how to prepare ponds, and how shipments are made. 1880. 1 p. 20 by 25cm.

156. Shipping label: *Fischerei-ausstellung*, Berlin. 1880. 1 p. 25.5 by 38cm.

157. Statistics of fishing vessels of the United States. Third edition of No. 11 revised. 1880. 2 pp. 35 by 43cm.

158. Blank for statement of number of licenses issued to vessels engaged in fishing in each district of the U. S., by ports. Hektograph. August, 1880. 1 p. 20 by 32cm.

159. Blank for statement of quantity of oil taken by vessels employed in the cod fisheries, by districts. 6 columns. Hektograph. August, 1880. 1 p. 20 by 32cm.

160. Blank for statement of product of the cod fishery, by customs districts. 6 columns. Hektograph. August, 1880. 1 p. 20 by 32cm.

161. Statement of the product of fisheries, other than cod, by customs districts. 6 columns. Hektograph. August, 1880. 1 p. 20 by 32cm.

162. Blank for the statement of bounties paid to fishing vessels, by customs districts. 6 columns. Hektograph. August, 1880. 1 p. 20 by 32cm.

163. Circular-letter, Taunton River fishermen, asking them to fill out No. 96. Hektograph. September 8, 1880. 2 pp. 20 by 25.

164. Circular-letter to Merrimack River fishermen, asking them to fill out No. 96. Hektograph. September 8, 1880. 2 pp. 20 by 25cm.

165. Blank for containing summary statement of goods exported from the United States, paying specific duty. 4 columns. Hektograph. 1 p. 20 by 32cm.

166. Blank for compiling foreign goods exported from the United States. Fish and oil. Dutiable. 13 columns. Hektograph. 1 p. 20 by 32cm.

167. Blank for compiling number and tonnage of vessels in the cod and mackerel fisheries, by districts. 6 columns. Hektograph. October 25, 1880. 1 p. 20 by 32cm.

168. Blank for compiling statement of the number and tonnage of vessels and seamen employed in the cod and whale fisheries. 7 columns. Hektograph. November 10, 1880. 1 p. 20 by 32cm.

169. Circular-letter to menhaden fishing firms, asking if ocean-temperature records have been kept. 5 questions. Hektograph. November 12, 1880. 1 p. 20 by 32cm.

170. Circular-letter asking naturalists and special correspondents to secure replies to Circular 55 from cities. Hektograph. November 17, 1880. 1 p. 20 by 25cm.

171. Circular-letter asking detailed response to questions relating to turtles, terrapin, and frogs. Hektograph. November 11, 1880. 1 p. 20 by 25cm.

172. Inquiry concerning terrapin, snapping and green turtles. 13 questions. To accompany No. 171. Hektograph. November 19, 1880. 1 p. 20 by 32cm.

173. Inquiries concerning frogs. 9 questions. To accompany No. 171. Hektograph. November 19, 1880. 1 p. 20 by 32cm.

174. Blank for compiling sponges, shells, and other commodities exported, by districts. 17 columns. Hektograph. November 20, 1880. 1 p. 20.5 by 32cm.

175. Blank for compiling turtles, dried oysters, cuttle-fish bone, cudbear, and other commodities entering into consumption imported. Hektograph. November 20, 1880. 1 p. 21.5 by 35.5cm.

176. Blank for compiling sponges, cuttle-fish bone, and miscellaneous products of the sea imported, by districts. Hektograph. November 20, 1880. 1 p. 21 by 31.5cm.

177. Circular-letter to superintendents of railroads, asking permission to transport live fish in baggage-cars during 1881. November 17, 1880. 1 p. 10.5 by 19cm.

178. Circular-letter soliciting answers concerning national history of lobsters. Hektograph. November, 1880. 2 pp. 19.5 by 25cm.

179. Questions upon natural history of lobster. To accompany No. 178. 113 questions. Hektograph. November 20, 1880. 8 pp. 20 by 32cm.

180. Circular-letter to railroads, asking permission to transport live fish in baggage-cars, similar to that granted by the Baltimore and Ohio Railroad. Hektograph. November 22, 1880. 20 by 25cm.

181. Questions upon the natural history of the lobster; abbreviated edition of No. 179. 37 questions. Hektograph. November 23, 1880. 3 pp. 20 by 32cm.

182. Blank for the statistical recapitulation of the oyster industries. 26 questions. Hektograph. November 24, 1880. 2 pp. 14 by 22cm.

183. Circular-letter asking for the return of the receipt for carp. Hektograph. November 26, 1880. 30 copies. 1 p. 20 by 25.5 cm.

184. Circular-letter soliciting information of the edible crabs and shrimps. Hektograph. December 10, 1880. 1 p. 20 by 25cm.

185. Inquiry concerning natural history of crabs. To accompany No. 184. 19 questions. Hektograph. December 10, 1880. 1 p. 20.5 by 32.5cm.

186. Inquiry concerning natural history of shrimps. To accompany No. 184. 17 questions. Hektograph. December 10, 1880. 1 p. 20.5 by 32.5cm.

187. Blank for weekly time report. 4 columns. Hektograph. April 10, 1880; amended December 11, 1880. 1 p. 16 by 20cm.

188. Circular-letter concerning obstructions in rivers, with blanks for nature of obstruction, distance from the mouth, &c. Hektograph. December 20, 1880. 1 p. 20 by 32cm.

189. [Serial mark 143.] Blank for transferring check-marks from circular returns relating to fish trade and consumption of fish (43 and 55). 1 p. 20 by 25.5cm.

190. [Serial mark 7-747 and 144.] Blank for compiling fish and oyster report, by counties, from circular returns relating to fish trade and consumption of fish (43 and 55). 1 p. 19.5 by 30cm.

191. [Serial mark 146.] Circular letter to persons interested in fish culture. To accompany No. 48. Hektograph. January 12, 1881. 16 by 20.5cm.

192. [Serial mark 147.] Circular letter upon the ascent of shad in the headwaters of rivers. 6 questions. Hektograph. January, 1881. 2 pp. 20 by 25cm.

193. Circular-letter soliciting information concerning fish trade and consumption. Hektograph. January 19, 1881. 1 p. 20 by 25cm.

194. [Serial mark 7-806 and 151.] Circular to dealers in fresh fish. 12 questions. 2 pp. 20.5 by 26.5cm.

195. Circular-letter announcing shipment of land-locked salmon eggs. Hektograph. January 20, 1881. 1 p. 20 by 25cm.

196. Inquiry concerning fish-hatching establishments. 10 questions. Hektograph. January 25, 1881. 1 p. 20 by 32cm.

197. [Serial mark 7-952 and 157.] Circular to dealers in salt fish. 9 questions. 1881. 1 p. 20 by 25.5cm.

198. Circular-letter to persons engaged in fish-hatching. To accompany No. 196. Hektograph. January 28, 1881. 1 p. 16 by 20.5cm.

199. Blank for alphabetical catalogue of fish culturists. 5 columns. February, 1881. Hektograph. 1 p. 20.5 by 32cm.

200. Blank for general result of hatching California salmon. 5 columns. February, 1881. Hektograph. 1 p. 20.5 by 31.5cm.

201. Blank for application for carp. 11 questions. Reprint of No. 145, revised. 1881. 2 pp. 20.5 by 25.5cm.

202. Blank for geographical catalogue of fish-culturists. 4 columns. Hektograph. February, 1881. 1 p. 20.5 by 32cm.

203. Blank for catalogue of persons engaged in fish-hatching. 5 columns. Hektograph. 1881. 1 p. 20.5 by 32cm.

204. Circular-letter and blank, inquiring the name of the water in which land-locked salmon have been placed. Hektograph. February 4, 1881. 1 p. 20.5 by 32cm.

205. Circular-letter inclosing order to baggage-masters, facilitating transportation of fish during 1881. Hektograph. February 11, 1881. 1 p. 20.5 by 25.5cm.

206. Circular-letter to packers of canned fish and other sea food, requesting dummies and labels. 5 questions. Hektograph. February 11, 1881. 2 pp. 20.5 by 32.5cm.

207. Blank for compiling information concerning obstructions in rivers. 7 columns. Hektograph. February 12, 1881. 1 p. 16 by 20.5cm.

208. Blank for summary of fish and other products of the sea imported annually. Hektograph. February, 1881. 1 p. 20 by 31.5cm.

209. Blank for summary of fish, oysters, oil, bone, spermaceti, and candles exported annually. Hektograph. February, 1881. 1 p. 20 by 31.5cm.

210. Blank for oil exported from the United States annually, by countries. 6 columns. Hektograph. February, 1881. 1 p., 2 forms. 20 by 31.5cm.

211. Blank for pickled and dried fish imported into the United States annually, paying specific rates of duty. 7 columns. Hektograph. February, 1881. 1 p. 20.5 by 31.5cm.

212. Circular-letter to medalists of the International Fishery Exhibition, inclosing a photograph of the medal. Hektograph. February 15, 1881. 1 p. 20 by 25cm.

213. Blank for fresh-fish dealers in cities of over 10,000 inhabitants. Hektograph. February 20, 1880. 1 p. 20.5 by 32cm.

214. Circular-letter requesting address of the principal dealers in salt and fresh fish in cities. Hektograph. February 25, 1881. 1 p. 20.5 by 32cm.

215. Blank for measuring the centers of distribution of fresh fish, salt fish, and oysters. 5 columns. Hektograph. March 1, 1881. 1 p. 20.5 by 32cm.

216. Blank for record of the work performed in the fishery division of the Tenth Census. 12 items. Hektograph. March 7, 1881. 1 p. 16 by 20.5cm.

217. Blank for outline of the localities to which each center of distribution send fresh or salt fish and oysters. Hektograph. March 20, 1881. 1 p. 12 by 21.5cm.

218. Blank for pickled herring and sardines imported, 1843–'80. 4 columns. Hektograph. March, 1881. 1 p. 21.5 by 35.5cm.

219. Blank for the value of marble, stone, and slates exported and imported by countries. 10 columns. Hektograph. April 23, 1881. 1 p. 21.5 by 35.5cm.

220. Circular-letter asking parties to verify statement concerning pickled sword-fish. 3 questions. Hektograph. April 23, 1881. 1 p. 19.5 by 25cm.

221. Circular-letter answering questions about fresh sword-fish. 4 questions. Hektograph. May 10, 1881. 1 p. 19.5 by 25cm.

222. Circular-letter to correspondents answering questions about sword-fish. 4 questions. Hektograph. May 13, 1881. 1 p. 19.5 by 25cm.

223. Circular-letter requesting the address of the principal dealers in salt fish. Hektograph. May 14, 1881. 1 p. 19.5 by 25cm.

224. Circular-letter to State Fish Commissioners, asking the results of hatching California salmon eggs donated by the U. S. Fish Commission. Hektograph. May 24, 1881. 1 p. 19.5 by 25cm.

225. Circular-letter to the secretaries of States requesting the last report of the State Fish Commissioners. Hektograph. May 25, 1881. 1 p. 19.5 by 25cm.

226. Circular-letter and inquiries concerning the constant use of fish-guano. 5 questions. Hektograph. May 30, 1881. 1 p. 16 by 20.5cm.

227. Circular-letter to city fish dealers, soliciting response to former inquiries concerning fish trade. Hektograph. June 10, 1881. 1 p. 13 by 21.5cm.

228. Circular-letter to State Commissioners requesting report upon the trout-eggs donated by the U. S. Fish Commission. June 11, 1881. 1 p. 19.5 by 25cm.

229. Circular-letter enforcing request for response to Circular No. 48. Hektograph. June 17, 1881. 1 p. 14 by 22cm.

230. Circular-letter requesting response to No. 197. Hektograph. June 22, 1881. 1 p. 14 by 22cm.

231. Circular-letter inclosing blank carp application, and offering to send the carp by express. October, 1881. 1 p. 20 by 25.5cm.

232. Circular-letter stating that fish are ready for distribution, and offering to send them by express. October 29, 1881. 1 p. 20 by 25.5cm.

233. Circular-letter to fish applicants who responded to No. 231 or 232, announcing shipment by express. 1 p. 20 by 25.5cm.

234. Orders issued by railroad companies to employés concerning the transportation of live fish in baggage-cars. April, 1881. 1 p. 10.5 by 18.5cm. Roan, vol. —, pp. —

235. Circular-letter transmitting accounts upon vouchers, and instructions concerning signatures. November, 1881. 1 p. 20.5 by 26cm.

236. Blank for voucher. Account of expenses of propagation of food-fishes, 1881–'82. July 24, 1881. 1 p., and filing blank on reverse. 20.5 by 25.5cm.

237. Circular-letter announcing trip of carp messenger, and instructions for regulating ponds and food. 1 p. 20.5 by 27cm.

238. Circular-letter announcing shipment to a central point, how to obtain the supply, transportation, care, and feeding. June, 1880. 1 p. 20.5 by 25.5cm.

239. Blank for compiling application for fish or eggs. 14 columns per folio. 1 p. 25.5 by 35.5cm. Bound volume. pp. 200±.

240. Blank for account-current of the United States with H. A. Gill, disbursing agent of the U. S. Fish Commission. 6 columns. 1 p. 19.5 by 35.5cm.

241. Blank for abstracts of disbursements by H. A. Gill, disbursing agent of the U. S. Fish Commission. 4 columns. 1 p. 20 by 32.5cm.

242. Blank letter for transmitting drafts on the Assistant Treasurer of the United States. 1 p. 20.5 by 25.5cm.

243. Circular-letter explaining how to fill carp blanks and obtain the fish. 1 p. 20.5 by 25.5cm.

244. Circular-letter inviting to meeting of fish commissioners of the several States of the Union. 1 p. 20.5 by 25.5cm.

245. Blank for statement of expenditure and balance. 6 columns. 1 p. 21.5 by 25.5cm.

246. Blank for recording the shipment of fish. 14 colums per folio. 1 p. 25.5 by 36.5cm. Bound volume. 200 pp.

247. Circular-letter and request for information concerning the fresh and pickled sword-fish sold in cities. Hektograph. November 29, 1881. 1 p. 20.5 by 31.5cm.

248. Circular-letter and request for information concerning pickled sword-fish. 6 questions. Hektograph. December 2, 1881. 1 p. 20.5 by 31.5cm.

249. Circular-letter to County Treasurers requesting the addresses of persons interested in fish propagation. December 14, 1881. 1 p. 16 by 20.5cm.

250. Circular-letter requesting parties to fill and return applications. December, 1881. 1 p. 12.5 by 20.5cm.

251. Blank for compiling applications to be filled by messenger on same trip. 7 columns. 1 p. 20.5 by 27cm.

252. Circular-letter requesting persons to file receipt for carp. 1 p. 14 by 16.5cm.

253. Postal-card acknowledgment of the receipt of carp application, and statement that notice of shipment will be forwarded. 1 p. 7.5 by 13cm.

254. (Serial mark 178.) Blank for requisition of articles or labor. March 12, 1882. 1 p. 29 by 25.5cm.

255. Blank for analysis of disbursements. 32 columns. 1 p. 38 by 42cm. 10 bound volumes, 196 pp. each.

256. Blank for compiling carp applications by Congressional districts. 8 columns. 1 p. 25.5 by 40.5cm.

257. Blank for library catalogue. 22 columns per folio. 1 p. 29 by 43.5cm. Bound volume.

258. Blank for pay-roll of the Fish Commission. 8 columns. 1 p. 25.5 by 42cm.

259. Circular-letter requesting information concerning men interested in the propagation of fish. April 3, 1881. 1 p. 20 by 16cm.

260. Orders issued by railroad companies to employés concerning the transportation of live fish in baggage-cars. April, 1882. 1 p. 10.5 by 18.5cm. Roan, volume —.

261. Blank for a receipt for carp. 5 items. 1 p. 7.8 by 13cm.

262. Blank for a receipt for fish or eggs. 10 items. Explanations on reverse. 2 pp. 11 by 17.5cm.

263. Circular-letter of Chas. G. Atkins, to recipients of Schoodic salmon-eggs, asking report on 21 items, success in hatching, &c. January, 1882. 1 p. 20 by 25.5cm.

264. Blank to show the condition of salmon-eggs when received at hatcheries. To accompany No. 263. January, 1882. 1 p. 20 by 25.5cm.

265. Blank postal card, U. S. Commission of Fish and Fisheries, with penalty notice. April 2, 1882. 7.7 by 12.9cm.

266. Circular-letter announcing that carp will be sent in cans by express on a stated day. November 20, 1881. 1 p. 20 by 25cm.

267. Reprint of 266 revised. April 5, 1882. 1 p. 19.7 by 23cm.

268. Circular-letter to carp applicants in Michigan, directing them to apply to Frank N. Clarke, Northville, Mich. Hektograph. February, 1882. 1 p. 20 by 25cm.

269. Postal card for messengers U. S. Fish Commission, to notify carp applicants where and when to meet them for fish. December, 1881. 1 p. 7.6 by 13cm.

270. Shipping-tag by Adams Express Company, with notice to express agents and messengers from Geo. W. Moss on reverse. 2 pp. 8 by 16cm.

271. Reprint of 270, with changes—instructions for care of the fish. 2 pp. 8 by 16cm.

272. Blank for certificate of general passenger agents, that prices charged are lowest rates. 1 p. 8 by 21cm.

273. Blank for certificate that articles or services have been duly received or performed. 1 p. 8 by 21cm.

274. Blank for certificate that bills are correct statements of expenses incurred in service of the U. S. F. C., &c. 1 p. 8 by 21cm.

275. Blank for receipt of check of Herbert A. Gill, on assistant treasurer U. S. 1 p. 7.5 by 19.5cm.

276. Reprint of No. 50. Blank for receipt for property of the U. S. F. C., and for enumerating articles. April 10, 1882. 1 p. 20 by 25cm.

277. Morning report of operations at the central hatching and distributing station. Blank for record of eggs handled. 10 columns. April 12, 1882. 1 p. 20.5 by 34.5 cm. Bound vol., 350 pp.±.

278, 279, 280, 281. (Transferred to list of important publications.)

282. Register of drawings. Blank for date, subject, artist, cost, when published, &c. 17 columns. 1 folio. 53 by 40.5cm. Bound volume.

283. Label for shipping salmon-eggs from Bucksport, Me., with directions for their care. 1 p. 18 by 22.5cm.

284. Postal to carp applicants in Kentucky, stating that a supply has been sent to Dr. Griffith for distribution. Reverse of No. 265. Hektograph. April 12, 1882. 1 p. 7.5 by 13cm.

285. Postal to carp applicants, concerning fish lost in transit by express. Reverse of No. 265. Hektograph. April 18, 1882. 1 p. 7.5 by 13cm.

286. Circular-letter, acknowledging preliminary reply on menhaden, and asking blank relating to menhaden, &c., be filled for current year. 1 p. 12.5 by 20.5cm.

287. Blank for receipt for carp received through Milton P. Peirce. On reverse blank for description of pond. 15 items. 2 pp. 8.5 by 14.5cm.

288. Blank for order for work or supplies, with stub for 7 items. January 29, 1879. 1 p. 11 by 28cm.

289. Reprint of 288. July 23, 1881. 1 p. 11 by 28cm.

290. Blank for sub-voucher. To accompany No. 236. July 24, 1881. 1 p., and filing-blank on reverse. 9 by 22cm.

291, 292, 293, 294, 295. (Transferred to list of important publications.)

296. Blank book for liabilities of the U. S. Commission of Fish and Fisheries. 8 columns per folio. July, 1880. 1 p. 20 by 24.5cm. Bound vol., paper cover. 28 pp.

297. Circular-letter, inclosing copies of No. 260. Hektograph. April 19, 1882. 1 p. 20 by 25.5cm.

298. Circular-letter, giving instructions to spawn-takers. Hektograph. April 20, 1882. 2 p. 20 by 25.5cm.

299. Blank for summary of carp distribution for the year 1881. 8 columns. Hektograph. April 25, 1882. 1 p. 20 by 32cm.

300. Postal card, stating that fish having died they will not be supplied until early next fall. Hektograph. April 26, 1882. 1 p. 7.5 by 13cm.

301. Circular-letter, inclosing carp blank. April 26, 1882. 1 p. 13 by 20cm.

302. Shad tickets of the U. S. Fish Commission, good for one shad each. July 1879. 1 p. 4 by 7.5cm.

303. Letter-head, U. S. Commission of Fish and Fisheries. 1 p. 20 by 25cm.

304. Envelope for U. S. Commission of Fish and Fisheries, with penalty notice attached. April, 1882. 1 p. 10 by 22.5cm.

305. Envelope for U. S. Commission of Fish and Fisheries, with penalty notice attached. April, 1882. 1 p. 8.5 by 15cm.

306. Analysis of disbursements of the U. S. Fish Commission. 23 columns per folio. 2 p. 39 by 42cm.

307. Register of letters received at the U. S. Fish Commission. 8 columns. 1882. 1 p. 25 by 29.5cm. Bound vol. 200 folios per vol.

308. Register of letters written at the U. S. Fish Commission. 8 columns. 1882. 1 p. 25 by 29.5cm. Bound vol. 200 folios per vol.

309. U. S. Fish Commission fish order-book; blank for name, address, No. of order and action taken, with stub for same. 1 p. 29 by 31cm. 9 bound volumes, 400 pp. each.

310. Postal card. Detailed report of eggs taken and fish on hand. 5 items. 5 columns. May 8, 1882. 1 p., with return address and penalty notice on reverse. 7.5 by 13cm.

311. Blank for compilation of names of applicants for shad, arranged by States. 4 columns. Hektograph. April 8, 1882. 1 p. 20 by 31.5cm.

312. Circular-letter to light-house keepers, giving instructions in regard to ocean-temperature blanks, with receipt for blanks. Hektograph. March 12, 1882. 1 p. 20 by 31.5cm.

313. Blanks for compilation of names of applicants for California trout, arranged by States. 7 columns. Hektograph. April 1, 1882. 1 p. 20.5 by 31.5cm.

314. Blanks for weekly time report. 4 columns. Reprint of 187. March 25, 1882. 1 p. 17.5 by 20cm.

315. Script letter-head, "U. S. Commission of Fish and Fisheries." May 25, 1882. 1 p. 20 by 25cm.

316. Block heading, U. S. Commission of Fish and Fisheries, "Memoranda." May 25, 1882. 1 p. 11 by 18cm.

317. Envelopes for U. S. Commission of Fish and Fisheries, with penalty notice attached. May 31, 1882. 1 p. 10.5 by 23.5cm.

318. Manilla envelope, U. S. Commission of Fish and Fisheries, with penalty notice attached. June 3, 1882. 1 p. 10 by 22.5cm.

319. Return envelope, "Prof. Spencer F. Baird, U. S. Commissioner of Fisheries," with penalty notice attached. June 5, 1882. 1 p. 9.5 by 21cm.

320. Blank for compiling the names of carp applicants, by Congressional districts. 8 columns. June 8, 1882. Reprint of No. 256. 2 p. 20 by 25cm.

321, 322, 323. (Transferred to list of important publications.)

324. Blank for recording applications for fish. 15 columns per folio. June 13, 1882. 1 p. 25 by 35cm. Bound volume. 150 folios.

325. Blank for recording applications for fish. 12 columns per folio. 1882. 1 folio. 25.5 by 70.5cm.

326. Letter head, *Internationale fischerei ausstellung in Berlin.* June, 1880. 1 p. 25.5 by 28cm.

327. Blank for requisition of articles or labor. July 8, 1882. Revise of No. 254. 1 p. 20 by 24.5cm.

328. Signal code of bell-calls. 1882. 1 p. 15.5 by 24cm.

329. Script letter-head, U. S. Commission of Fish and Fisheries. July 12, 1882. 1 p. 20 by 25cm.

330. (Transferred to list of important publications.)

331. Pay-roll of the U. S. Fish Commission for 1883. 8 columns. Reprint of No. 258. July 24, 1882. 1 p. 25.5 by 42cm.

332. Blank for order for supplies for London Fishery Exhibition, with stub. August 1, 1882. 1 p. 12.5 by 27cm.

333. Blank for voucher. Account of the appropriation for International Fishery Exhibition at London, 1883. August 1, 1882. 1 p., and filing on reverse. 20 by 25cm.

334. Blank for application for carp. 11 items. Reprint of No. 201. October 3, 1882. 2 pp. 20 by 25.5cm.

335. Postal acknowledging the receipt of application for carp, and announcing that the application will be filled as soon as supply is available. October 4, 1882. 1 p., and penalty notice on reverse. 7.5 by 13cm.

336. Envelope for "U. S. Commission of Fish and Fisheries," with penalty notice attached. October 19, 1882. 1 p. 12.5 by 29.5cm.

337. Postal announcing carp sent to central point to be expressed to address named in application. October 30, 1882. 1 p. and penalty notice on reverse. 7.5 by 13 cm.

338. Postal messenger's announcement that carp have been sent by express; pail to be paid for; receipt to be returned. October 30, 1882. 1 p., and penalty notice on reverse. 7.5 by 13cm.

339. Postal blank for receipt for carp. October 31, 1882. 1 p., and return address and penalty notice on reverse. 7.5 by 13cm.

340. Blank for receipt of transportation request from Herbert A. Gill. October 31, 1882. 1 p. 15.5 by 19.5cm. Bound volume. 100 pp. 2 receipts on each page.

341. Blank for receipt of cash on account from Herbert A. Gill. October 31, 1882. 1 p. 15.5 by 19.5cm. Bound volume. 100 pp. 2 receipts on each page.

342. Abstract of disbursements, by Herbert A. Gill, disbursing agent of the U. S. Fish Commission. 4 columns. October 30, 1882. 1 p. 20 by 32.5cm.

343. Circular-letter, transmitting accounts upon vouchers, and instructions concerning signatures. Reprint of No. 235. October 30, 1882. 1 p. 20 by 25cm.

344. Postal announcing Fish Commission Report exhausted. October 31, 1882. 1 p., and penalty notice on reverse. 7.5 by 13cm.

345. Blank for compiling applications for messengers to fill. 7 columns. Reprint of No. 251. 1 p. 20.5 by 27cm.

346. Blank shipping-tag containing carp receipt; gives directions for taking care of the fish. October 31, 1882. 2 pp. 8 by 13.5cm.

347. Blank receipt and invoice for carp shipment, with instructions to collect 20 cents and charges from consignee. 10 columns. November 4, 1882. 2 pp. 21 by 35cm.

348. Postal announcing carp sent by express. Charges includes pail, which is not to be returned. November 6, 1882. 1 p., and penalty notice on reverse. 7.5 by 13cm.

349. Register of property of the U. S. Fish Commission. 12 columns. November 11, 1882. 1 p. 27 by 44cm. Bound volume. 244 pp.

350. Circular-letter inclosing blank carp application, with instructions for indorsement. Reprint of No. 301. November 7, 1882. 1 p. 12.5 by 20.5cm.

351. Circular-letter to railroads, asking permission to transport live fish in baggage-cars during the year 1883. November 15, 1882. 1 p. 11 by 18.5cm.

352. Postal messenger's announcement that carp have been sent by express; pail to be paid for and receipt returned. Reprint of No. 338. November 15, 1882. 1 p., and penalty notice on reverse. 7.5 by 13cm.

353. Register of requisitions of U. S. Fish Commission. 11 columns. November 16, 1882. 1 p. 27 by 44cm. Bound volume. 244 pp.

354. Signal code of bell-calls at Fish Commission Office. November 15, 1882. 1 p. 16 by 30.5cm.

355. Script letter-heading. U. S. Commission of Fish and Fisheries; unruled. November 15, 1882. 1 p. 20 by 25cm.

356. Circular letter of Southern Express Company, giving permit to transport fish as desired on passenger trains. March 23, 1875. 20.5 by 25.5cm.

357. Circular-letter to State secretaries, asking questions regarding State Fish Commission. 7 questions. 1 p. 20 by 25cm.

358. (Transferred to list of important publications.)

359. Blank for voucher. Account of expenses of Berlin Fishery Exhibition. March, 1880. 1 p., and filing on the reverse. 20.5 by 25.5cm.

360. Blank for sub-voucher. Account of Berlin Fishery Exhibition. March, 1880. 1 p., and filing on reverse. 9 by 21.5cm.

361. (Transferred to list of important publications.)

362. Envelopes, U. S. Fish Commission, to be used in the distribution of carp by express companies. October, 1881. 1 p. 10 by 24cm.

363. (Transferred to list of important publications.)

364. Label for shipping packages to Wood's Holl, Mass. New York and Boston Dispatch Express Company. August, 1882. 1 p. 12.5 by 20.5cm.

365. Return envelope. "Prof. Spencer F. Baird, Wood's Holl, Mass." Smithsonian frank. August, 1882. 1 p. 10.5 by 24.5cm.

366. Return envelope. "G. Brown Goode, Smithsonian Institution, Washington, D. C." Fish Commission frank. August, 1882. 1 p. 10.5 by 24.5cm.

367. Return envelope. "C. W. Smiley, 1443 Mass. ave., Washington, D. C." Fish Commission frank. August, 1882. 1 p. 11.5 by 26.5cm.

368. Bill of fare of mess at Wood's Holl. August, 1882. 1 p. 10 by 15cm.

369. Signal code of telephone-calls at Wood's Holl, Mass., 1882. August, 1882. 1 p. 12 by 16.5cm.

370. Label-card for shipping packages to Prof. S. F. Baird, 1445 Mass. ave., Washington, D. C. October, 1882. 1 p. 7.5 by 13cm.

371. Directions in regard to Wood's Holl House linen as differently marked. August, 1882. 1 p. 18 by 24.5cm.

372. Postal messenger's announcement that carp have been sent by express; pail to be paid for and receipt returned. Hektograph. November, 1882. 1 p. 7.5 by 13cm.

373. Circular-letter announcing carp sent to central point to be expressed to address named in application. Hektograph. October, 1882. 1 p. 20 by 25cm.

374. Postal blank receipt for carp. No frank. 1 p., and address on reverse. 7.5 by 13cm.

375. Library catalogue-cards of U. S. Fish Commission. November 24, 1882. 1 p. 12 by 17cm.

376. Circular-letter to railroads, acknowledging receipt of letter granting transportation of live fish in baggage-cars. Hektograph. November 23, 1882. 1 p. 20 by 25cm.

377. Blank request for transportation, with blank certified receipt. Stub attached for 10 entries. December 29, 1882. 16.5 by 39.5cm. 10 volumes, 100 pp. each.

378. Circular-letter giving the number of pages, plates, and signatures of Vol. I, Fish Commission Bulletin. Blank slip, with 3 questions attached, to be answered and returned. Hektograph. November 25, 1882. 1 p. 19.5 by 31cm.

379. Circular-letter of appointment in service of U. S. Commission of Fish and Fisheries. December 7, 1882. 1 p. 20 by 25cm.

380. Circular-letter to railroad companies, asking them to transport car and 5 messengers at special rate of 20 cents per mile. Hektograph. November 29, 1882. 2 pp. 21.5 by 35.5cm.

381. Circular-letter calling attention to plan of inventory of Fish Commission property, to be taken January 1, 1883. 10 classes. Hektograph. December 4, 1882. 2 pp. 21.5 by 35.5cm.

382. Circular-letter to State Fish Commissioners, asking them to fill the inclosed blank (No. 383) for Fish Commission Bulletin, and offering volume II by signature, as published. Hektograph. December 7, 1882. 1 p. 20 by 25cm.

383. Blank for State Fish Commissioners to fill. 7 questions. To accompany No. 382. Hektograph. December 7, 1882. 1 p. 20 by 31cm.

384. Notice to callers that Professor Baird will not see any one on business before 10.30 a. m. 1 p. 8 by 10cm.

385. Official envelope, "U. S. Commission of Fish and Fisheries, steamer Fish Hawk," with penalty notice attached. December 20, 1882. 1 p. 8.5 by 15cm.

386. Official envelope, "U. S. Commission of Fish and Fisheries, steamer Fish Hawk," with penalty notice attached. December 20, 1882. 1 p. 10 by 22cm.

387. Letter-head, "U. S. Commission of Fish and Fisheries, steamer Fish Hawk." January 8, 1883. 1 p. 19.5 by 25cm.

388. Postal-card receipt for signatures 1-10 of Fish Commission Bulletin, 1882. Hektograph. December 2, 1882. 1 p., and penalty notice on reverse. 7.5 by 13cm.

389. Blank for invoice of U. S. Fish Commission property, with certified receipt attached. 5 columns. December 29, 1882. 1 p., and filing on reverse. 20.5 by 26cm.

390. Blank for application for space at London Fishery Exhibition, 1883. To accompany No. 391. 7 items. December 23, 1882. 1 p. 21.5 by 35.5cm.

391. Circular-letter inviting fish packers and dealers in the United States to exhibit specimens at London Fishery Exhibition. December 20, 1882. 1 p. 21.5 by 35.5cm.

392. (Transferred to list of important publications.)

393. Circular-letter to State commissioners of fisheries, inclosing classification London Fishery Exhibit, and asking for State commissioners' reports. December 22, 1882. 1 p. 21.5 by 35.5cm.

394. Circular-letter acknowledging receipt of application, and advising them to apply in person at the United States carp ponds at Washington for fish. Hektograph. November, 1881. 1 p. 20 by 25.5cm.

395. Circular-letter to railroad auditors, asking them to render bill on transportation request issued. December 29, 1882. 1. p 20 by 25.5cm.

396. Blank for monthly liabilities against the U. S. Fish Commission. 5 columns. December 29, 1882. 1 p. 20 by 25cm.

397. Circular-letter to State Fish Commissioners and other fish culturists, asking for their photographs for London Exhibition. January 13, 1883. 1 p. 8 by 13cm.

398. Official envelope, "U. S. Commission of Fish and Fisheries, steamer Fish Hawk," with penalty notice attached. 1 p. 8.5 by 15cm.

399. Catalogue card for address of recipients of Report and Bulletin of U. S. Fish Commission. October, 1882. 1 p. 10.5 by 17.5cm.

400. Blank for voucher. Account of expenses of propagation of food-fishes, 1883. January 11, 1883. 1 p., and filing blank on reverse. 20 by 25cm.

401, 402. (Transferred to list of important publications.)

403. Orders issued by railroad companies concerning transportation of live fish in baggage-cars during 1883. January 12, 1883. 1 p. 11 by 18.5cm. Roan volume, 87 pp. each.

404, 405. (Transferred to list of important publications.)

406. Blank for sub-voucher, London Exhibition, 1883. To accompany No. 333. August, 1882. 1 p., and filing on reverse. 9 by 22cm.

407. Circular-letter to Pennsylvania carp applicants, announcing fish direct by express from Washington. Hektograph. January 16, 1883. 1 p. 20 by 25cm.

408. Check-list of numbers. 7 columns. January 23, 1883. 1 p. 21.5 by 35.5cm.

409. Circular-letter to creditors of the U. S. Fish Commission, calling in accounts. Feburary 2, 1883. 1 p. 20 by 25.5cm.

410. F. C. Library loan card, giving No. of book, time of taking, and return. February 5, 1883. 1 p. 8 by 13cm.

411. Circular-letter giving general plan of London Exhibition and invitation to participate. July 26, 1882. 2 pp. 21.5 by 35cm.

412. Return envelope Prof. Spencer F. Baird, for Disbursing Agent U. S. Fish Commission, with penalty notice attached. February 12, 1883. 1 p. 9 by 21.5cm.

413. Circular-letter offering Fish Commission Bulletin by signatures, as published, in place of bound volume. February 12, 1883. 1 p. 12 by 20cm.

414. Circular-letter requesting parties to send for missing parts of Fish Commission Bulletin at once, blank slip attached, with 3 questions to be answered and returned. Hektograph. February 10, 1883. 1 p. 20 by 25.5cm.

415. Blank for receipt of check. Reprint of No. 275. February 12, 1883. 1 p. 7.5 by 19.5cm.

416. Postal-blank receipt for signatures of bulletin. February 12, 1883. 1 p., and penalty notice on reverse. 8 by 13cm.

417. (Transferred to list of important publications.)

418. Blank for voucher account of the appropriation for International Fishery Exhibition, at London, 1883, W. V. Cox, disbursing agent, Treasury Department. March 12, 1883. 1 p., with filing on the back. 20 by 24.5cm.

419. (Transferred to list of important publications.)

420. Circular-letter calling in accounts against the International Fishery Exhibition. March 1, 1883. 1 p. 14 by 21cm.

421. Blank for extracts of letters for Fish Commission file. Hektograph. April 7, 1883. 1 p. 20 by 25.5cm.

422. Circular-letter asking parties to file receipt for carp. Reprint of No. 252. April 10. 1 p. 14 by 16.5cm.

423. Circular-letter inclosing carp application. General distribution about the 1st of November. Revise of No. 301. April 15. 1 p. 13 by 20cm.

424. Blank for record of observations at hatching station, date, temperature, wind, sky, and tide. Revise of No. 61. May 1, 1883. 26 columns. 1 p. 39 by 53.5cm.

425. Circular-letter inviting suggestions on construction of a fish-way at Great Falls, of the Potomac River. Hektograph. April 10, 1883. 2 p. 205 by 32cm.

426. Blank card for hatching record. 8 items: Number of eggs, whence received, loss, temperature, &c. April 20, 1880. 1 p. 7 by 9cm.

427. Letter-head of "Schoodic Salmon-breeding Establishment." 1 p. 20 by 26.5cm.

428. Label addresses to parties receiving Fish Commission Bulletin signatures. Hektograph. April 15, 1883. 27 separate labels, each 5 by 10cm.

429. Circular-letter transmitting baggage-car orders, relating to transportation of fish. April 4, 1883. 1 p. 20 by 25.5cm.

430. Fish-egg ticket, giving name of party, kind of fish, number of eggs received, and number of eggs good. April 25, 1883. 1 p. 2 tickets each. 13 by 13cm.

431. Postal blank for receipt of U. S. Fish Commission Bulletin, with offer to send by signatures instead of by bound volume. May 25, 1883. 1 p., with return address and penalty clause on reverse. 8 by 13cm.

432. Return envelope, C. W. Smiley, 1443 Mass. ave., Washington, D. C. Fish Commission frank. June 5, 1883. 1 p. 23 by 29cm.

433. Pay-roll of the United States Fish Commission for 1884. 8 columns. Reprint of No. 331. June 8, 1883. 1 p. 255 by 42cm.

434. Blank for voucher. Account of expenses of propagation of food-fishes, 1884. June 8, 1883. 1 p., and filling blank on reverse. 20 by 25cm.

435. Blank-book for record of Fish Commission bills referred. 9 columns per folio. June 22, 1883. 1 p. 20 by 25 cm. Bound vol., paper cover. 44 pp.

436. Blank-book for statement of expenditures of U. S. Fish Commission. 12 columns per folio. June 22, 1883. 1 p. 30 by 30cm. Bound vol. 300 pp.

437. Circular-letter asking Congressmen to file carp application of constituents. July 9, 1883. 1 p. 13 by 20.5cm.

438. Blank for carp-culture returns. 16 questions. July 12, 1883. 1 p. 20.5 by 35.5cm.

439. Circular-letter to carp-culturists asking them to fill and return No. 438. July 12, 1883. 1 p. 13 by 20.5cm.

440. Circular-letter inclosing form of Quarterly Return of Property of U. S. Commission of Fish and Fisheries, with instructions. July 12, 1883. 1 p. 13 by 20.5cm.

441. Circular-letter to light-house keepers, giving instructions regarding ocean temperature blanks, with receipt for blanks. Hektograph. July 14, 1883. 1. p. 20.5 by 32cm.

442. Circular-letter asking U. S. Fish Commission employés to fill and return No. 443, July 14, 1883. 1 p. 20 by 25cm.

443. Blank for return for Biennial Register. 7 items. July 14, 1883. 1 p. 20 by 25cm.

444. Blank for extracts from carp-culture returns, No. 438. Hektograph. July 20, 1883. 1 p. 20 by 25cm.

445. Circular-letter to light-house keepers announcing Fish Commission Reports III. IV, and V, and Vol. I of the Bulletin. Hektograph. July 23, 1883. 1 p. 20.5 by 25cm.

446. Circular-letter regarding the edible qualities of carp, with instructions how to prevent a soft or muddy taste. Hektograph. July 28, 1883. 1 p. 20.5 by 25.5cm.

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9.—FOUR TABLES SHOWING THE AMOUNT OF PUBLIC MONEY APPROPRIATED FOR CARRYING ON THE UNITED STATES COMMISSION OF FISH AND FISHERIES AND THE VARIOUS STATE COMMISSIONS FROM 1865 TO 1882, INCLUSIVE.

By CHAS. W. SMILEY.

The tables which are presented herewith were originally designed in 1880, being brought down to that date and exhibited at the Berlin Exhibition. They have now been completed for the use of the London Exhibition. The data have been derived from the records of the United States Fish Commission and from correspondence held with the secretaries of state and the fish commissioners of the various States of the Union. The tables may consequently be regarded as very accurate.

TABLE I.—*Appropriations for the United States Fish Commission work, 1871–'83.*

Fiscal year.	Inquiry.	Illustration.	Propagation.	Hatcheries and ponds.	Steam vessels.	Railroad car.	Rent.	Total.
1871–'72	$5,000 *3,500	.....	.....	.....	.....	.....	.....	$8,500 00
1872–'73	5,000	$500	$15,000 *10,000	.....	.....	.....	.....	30,000 00
1873–'74	5,000	1,000	17,500 *15,000	.....	.....	.....	.....	38,500 00
1874–'75	5,000	1,000	17,500	.....	.....	.....	.....	23,500 00
1875–'76	5,000	1,000	47,500 17,500	.....	.....	.....	.....	71,000 00
1876–'77	5,000	1,000	30,000 *045	.....	.....	.....	.....	36,045 00
1877–'78	.....	1,000	50,000 *17,500	$2,200 00	.....	.....	.....	70,700 00
1878–'79	.....	1,000	20,000 50,000	5,000 00	.....	.....	.....	76,000 00
1879–'80	3,500	1,000	75,000 15,000	5,000 00	$45,000 12,500	.....	.....	157,000 00
1880–'81	3.500	1,000	85,000	5,000 00 12,000 00	15,000	.....	.....	121,500 00
1881–'82	3,500	1,000	95,000 35,000	5,000 00 10,000 00 *5,001 45	15,000 115,709 *42,000	.....	$1,500	328,710 45
1882–'83	3,500	1,000	115,000	30,000 00	25,000 45,000	$8,000	1,500	229,000 00
Total	47,500	10,500	727,545	79,201 45	315,209	8,000	3,000	1,190,955 45

* Deficiency appropriation.

1879–'80. Appropriation for the International Fishery Exhibition in Berlin, $20,000.
1882–'83. Appropriation for the International Fishery Exhibition in London, $59,000.

The State appropriations are put down under the years in which they were made, which usually are the years preceding the expenditure. This explains why the following tables close with 1882.

TABLE II.—*Appropriations for the work of State Fish Commissions, arranged in alphabetical order.*

	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882	Total.
Alabama							—*	—	—	—	—	—	—	—	—	—	—	—	
Arizona																	$250	$250	$500
Arkansas																	—	—	
California						$2,500	$2,500	$2,000	$2,500	$2,500	$5,000	$5,009	$5,000	$5,000	$5,000	$5,000	5,000	5,000	52,000
Colorado													200	200	1,000	1,000	6,000	3,250	11,650
Connecticut		—	—	$4,000	$4,000	$3,000	$3,000	$3,000	5,000	5,000	5,000	3,000	1,800	1,000	3,000	2,500	5,000	5,000	53,300
Delaware																	150	150	300
Georgia												500	500	500	500	500	500	500	3,500
Illinois											—	—	—	—	—	2,000	1,000	2,500	5,500
Indiana																	1,000	1,000	2,000
Iowa										1,500	1,500	4,375	5,575	4,200	4,200	3,700	3,700	3,700	32,450
Kansas													500	500	500	500	—	1,000	3,000
Kentucky												1,500	1,500	1,500	1,500	2,500	2,500	2,500	13,500
Maine			1,000	1,000	3,000	2,000	2,000	2,500	3,500	4,500	1,500	2,500	3,700	3,700	—	6,075	5,000	5,000	46,975
Maryland										6,500	6,500	13,000	13,000	13,000	13,000	11,500	10,000	10,000	96,500
Massachusetts	—	$7,000	10,000	12,000	2,500	4,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	95,500
Michigan									7,500	7,500	7,000	7,000	7,000	7,000	5,000	5,000	8,000	7,500	68,500
Minnesota										500	1,000	1,000	5,000	5,000	5,000	5,000	5,000	5,000	32,500
Missouri													500	500	3,000	3,000	3,500	3,500	14,000
Nebraska															500	500	3,700	3,700	8,400
Nevada													500	500	2,000	2,000	1,000	1,000	7,000
New Hampshire		100	1,000	2,071	1,429	1,231	1,864	1,300	2,443	1,950	1,990	776	1,528	3,204	2,077	2,000	2,000		26,463
New Jersey						—	—	1,500	1,500	2,000	3,000	2,500	5,000	4,000	5,000	5,000	4,000		33,500
New York				1,000	10,000	10,000	15,000	15,000	15,000	10,000	29,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	210,000
North Carolina													—	—	—	—	3,214	8,012	11,226
Ohio									500	500	5,000	5,000	4,000	5,000	—	9,000	5,000	5,000	39,000
Oregon																—	—	—	
Pennsylvania		—	—	—	—	—	—	—	18,080	18,080	5,470	15,000	8,000	10,000	15,000	10,000	7,500	7,500	114,630
Rhode Island				—	—	1,000	2,500	1,500	1,500	1,500	1,000	500	—	—	—	1,000	1,000		11,500
South Carolina														—	800	—	3,156	2,286	6,242
Tennessee													—	—	—	—	—	—	
Texas															—	—	—	5,000	5,000
Utah							—	—	—	—	—	—	—	—	—	—	—	850	850
Vermont	—	—	106	100	231	680	321	415	531	1,335	775	761	545	1,000	1,000	1,000	1,000	1,000	10,800
Virginia										—	2,500	2,500	2,500	2,500	4,000	2,500	2,500	2,500	21,500
Washington													—	—	—	—	—	—	
West Virginia													1,500	1,500	1,600	1,000	2,000	500	8,100
Wisconsin									500	360	2,000	10,000	8,000	8,000	8,000	2,000	7,000	7,000	52,860
Wyoming															—	800	800	750	2,350
Total		7,100	12,106	20,171	21,160	24,411	31,685	32,215	63,554	68,725	83,235	94,912	95,848	97,804	101,677	105,075	120,470	120.948	1,101,096

NOTE.—The following States and Territories have not as yet appointed Fish Commissioners: Dakota, Florida, Idaho, Louisiana, Mississippi, Montana, New Mexico.

* The dash is used in the above columns to denote the existence of a commission, but without appropriations.

TABLE III.—*Appropriations for the work of the State Fish Commissions, arranged in the order of their organization.*

No.	State.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	Total.
1	Massachusetts	—	$7,000	$10,000	$12,000	$2,500	$4,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$95,500
2	Vermont	—	—	106	100	231	680	321	415	531	1,335	775	761	545	1,000	1,000	1,000	1,000	1,000	10,800
3	Connecticut		—	—	4,000	4,000	3,000	3,000	3,000	5,000	5,000	5,000	3,000	1,800	1,000	3,000	2,500	5,000	5,000	53,360
4	New Hampshire		100	1,000	2,071	1,429	1,231	1,364	1,300	2,443	1,950	1,990	776	1,528	3,204	2,077	2,000	2,000		26,463
5	Pennsylvania		—	—	—	—	—	—	—	18,080	18,080	5,470	15,000	8,000	10,000	15,000	10,000	7,500	7,500	114,630
6	Maine			1,000	1,000	3,000	2,000	2,000	2,500	3,500	4,500	1,500	2,500	3,700	3,700	—	6,075	5,000	5,000	46,975
7	New York				1,000	10,000	10,000	15,000	15,000	15,000	10,000	29,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	210,000
8	Rhode Island				—	—	1,000	2,500	1,500	1,500	1,500	1,000	500	—	—	—	1,000	1,000		11,500
9	California						2,500	2,500	2,000	2,500	2,500	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	52,000
10	New Jersey						—	—	1,500	1,500	2,000	3,000	2,500	5,000	4,000	5,000	5,000	4,000		33,500
11	Alabama							—	—	—	—	—	—	—	—	—	—	—	—	
12	Utah							—	—	—	—	—	—	—	—	—	—	—	850	850
13	Michigan									7,500	7,500	7,000	7,000	7,000	7,000	5,000	5,000	8,000	7,500	68,500
14	Ohio									500	500	5,000	5,000	4,000	5,000	—	9,000	5,000	5,000	39,000
15	Wisconsin									500	360	2,000	10,000	8,000	8,000	8,000	2,000	7,000	7,000	52,860
16	Iowa										1,500	1,500	4,375	5,575	4,200	4,200	3,700	3,700	3,700	32,450
17	Maryland										6,500	6,500	13,000	13,000	13,000	13,000	11,500	10,000	10,000	96,500
18	Minnesota										500	1,000	1,000	5,000	5,000	5,000	5,000	5,000	5,000	32,500
19	Virginia										—	2,500	2,500	2,500	2,500	4,000	2,500	2,500	2,500	21,500
20	Illinois											—	—	—	—	—	2,000	1,000	2,500	5,500
21	Arkansas												—	—	—	—	—	—	—	
22	Georgia												500	500	500	500	500	500	500	3,500
23	Kentucky												1,500	1,500	1,500	1,500	2,500	2,500	2,500	13,500
24	Colorado													200	200	1,000	1,000	6,000	3,250	11,650
25	Kansas													500	500	500	500	—	1,000	3,000
26	Missouri													500	500	3,000	3,000	3,500	3,500	14,000
27	Nevada													500	500	2,000	2,000	1,000	1,000	7,000
28	North Carolina													—	—	—	—	3,214	8,012	11,226
29	Tennessee													—	—	—	—	—	—	
30	Washington													—	—	—	—	—	—	
31	West Virginia													1,500	1,500	1,600	1,000	2,000	500	8,100
32	South Carolina														—	800	—	3,156	2,286	6,242
33	Nebraska															500	500	3,700	3,700	8,400
34	Wyoming															—	800	800	750	2,350
35	Texas															—	—	—	5,000	5,000
36	Oregon																—	—	—	
37	Arizona																	250	250	500
38	Delaware																	150	150	300
39	Indiana																	1,000	1,000	2,000
	Total		7,100	12,106	20,171	21,160	24,411	31,685	32,215	63,554	68,725	83,235	94,912	95,848	97,804	101,677	105,075	120,470	120,948	1,101,096

As is shown, the total amount of money appropriated by the United States Government thus far for the service of the United States Commission is $1,190,955.45, and the total amount appropriated for the service of the various State Commissions is $1,110,096, making a total, to the close of the year 1882, of $2,292,051.45. If this sum should seem large to any one when examining the actual fruits of fish-culture, it is to be remembered that a large per cent. of it represents permanent investments in the way of hatching-houses, apparatus, ponds, &c., and, in the case of the United States Commission, of three steamers—the "Lookout," "Fish Hawk," and "Albatross"—all of which investments, being of a permanent nature, will not need to be renewed, to any considerable extent, during the next decade. However the money may have been expended, one thing will be made very apparent by an examination of Table IV, viz, that an exceedingly small proportion of it has been paid out in salaries, the United States Commissioner and nearly all of the State Commissioners having served from the beginning without remuneration.

TABLE IV.—*Salaries of Commissioners and Superintendents of State Fish Commissions.*

State.	Number of Commissioners.	Salary of Commissioners.	Salary of Superintendents.
Alabama	2	None	
Arizona	3	None	
Arkansas	3	None	
California	3	None	$150 per month.
Colorado	1	None	$900 per annum.
Connecticut	3	$3 per day when at work	
Delaware	1	None	
Georgia	1	None	
Illinois	3	None	
Indiana	1	None	
Iowa	1	Commissioner, $1,200; assistant, $600 per year	
Kansas	1	$3 per day for 50 days	
Kentucky	10	None	$900 per year.
Maine	3	Two, $500 each and expenses	
Maryland	2	$1,500 each	
Massachusetts	3	One at $150 per month	
Michigan	3	None	$1,200 per annum.
Minnesota	3	None	$2,000 per annum.
Missouri	3	None	$75 per month; also a secretary, at $500 per annum
Nebraska	3	None	$600 per annum.
Nevada	1	None	
New Hampshire	3	$3 per diem when at work	
New Jersey	3	None	
New York	4	None	$3,000 per annum.
North Carolina	1	$1,500 per annum; assistant, $720.	
Ohio	3	None	$1,200 and $800 per year.
Oregon	1	None	
Pennsylvania	6	None	$900 and $800 per annum.
Rhode Island	3	None	
South Carolina	1	None	$720 per annum.
Tennessee	3	None	
Texas	1	$1,500 per annum	
Utah	1	None	
Vermont	2	None	
Virginia	1	None	
Washington	1	None	
West Virginia	3	None	
Wisconsin	6	None	
Wyoming	1	None	

10.—SOME OF THE EARLY RESULTS OF THE INTRODUCTION OF COD GILL-NETS AT GLOUCESTER, MASSACHUSETTS, 1880-1881.

By S. J. MARTIN.

[Letters to Prof. S. F. Baird.]

A few remarks on the cod gill-nets used by Capt. George H. Martin on the schooner Northern Eagle. He set them one night on the Honey-pinks, and got 1,000 pounds of cod; but the bottom was rocky, and the nets were somewhat injured. Afterwards, he set them in Spanish Bay, and obtained 4,000 pounds in two nights. The fish were very large, averaging 22 pounds apiece. The catch of the nets was greater than that of the trawls. One boat fishing close to the nets with 10,000 hooks got 2,000 pounds. Captain Martin thinks the nets will work well. Those he has are 50 fathoms long and 3 fathoms deep, with glass ball floats, like those which we used; but the twine is too small and breaks easily. He has gone to Boston to get eight more, made of salmon twine, with a length of 100 fathoms each and a 10-inch mesh. The fish are scarce. I will keep you posted on the nets.

GLOUCESTER, MASS., *December* 1, 1880.

The schooner Northern Eagle made a second trip down in the bay and obtained 6,000 pounds of large cod, which were sold in Boston for 3½ cents per pound. She had no bait bill. The schooner Breeze went out at the same time, and had a bait bill of $54. She used 10,000 hooks on the same ground where the nets were set and took 7,000 pounds, half of her fish being small.

They are going to have three nets, 50 fathoms long, to a dory, which will make twenty-seven in all. I think that after they are equipped they will get a good trip in two nights. The men no longer get their fingers cold by cutting up frozen herring, and do not have the trouble of baiting trawls. The decks are clear, and when the nets are hauled the fish are put into a pen on deck and salted. The nets have, each, twenty two glass-ball floats, and twenty-two bricks for sinkers. The herring catchers don't like to see them introduced.

GLOUCESTER, MASS., *December* 10, 1880.

The Northern Eagle has made a third trip to the bay, with the cod gill-nets. She was gone two days. The weather was bad, but they set the nets five times and got 15,000 pounds of large cod, averaging 23 pounds apiece. Eight thousand pounds were taken at one haul. The first nets they had are condemned; the twine of which they were made was too small and they were torn all to pieces. They now have twenty-four nets, 50 fathoms long, with a 10-inch mesh, all made of salmon

twine. Ipswich Bay is a hard place to fish in with nets. The fish are all caught on a place ten miles long northeast and southwest, and two miles wide southeast and northwest. If one gets outside of that range he will take nothing. There are fifty sail of vessels fishing on that small piece of ground. The vessels will average six dories each, and each dory sets 1,000 hooks. The Northern Eagle set her nets one night outside the trawls, and got only 300 pounds of fish. The nets were then taken up and set on a bunch of rocks, and there they caught plenty. One vessel set her trawls across the nets and hauled one up and cut it in two. I think that in the spring, when the bait gets scarce, some of the vessels will go to George's, and the Northern Eagle will do better, as she can then set her nets in deeper water. She has done as well as the trawlers, and has had no bait-bill to pay; the last morning the nets were hauled one man got 68 large fish in one net. The water was 11 fathoms deep where the fish were taken. They have to lie still all day, as no fish are caught in the nets except at night.

GLOUCESTER, MASS., *December* 28, 1880.

The schooner Northern Eagle has made a trip to Ipswich Bay and has done well. She sold 19,300 pounds in Portsmouth and 15,500 pounds in Gloucester. They under-run their nets seven mornings. None of the trawlers got half as many in the same time. They never took their nets up till they got ready to come home. They had them down a week and three days; got 8,000 pounds one haul. The fish they landed in Portsmouth averaged 24 pounds each. The trawlers say the fish are scarce in Ipswich Bay. One vessel went out when my son, George H. Martin, did, and arrived this morning with 4,000 pounds. They did not get their nets torn much this time. The crew are as proud as a dog with two tails; no bait-bill; no trawls to fix. The trawlers have not bothered them much this time; they lose too many hooks. There are two vessels at Portsmouth which are going to have nets. I think some of the boats here will have nets. Most of the shore boats will have nets in the spring. When bait gets scarce the nets will do well. There were 52 vessels fishing in Ipswich Bay last week—a large fleet for so small a place. The fish are full of ripe spawn. I saw four and a half barrels taken from 15,000 pounds of fish. The female fish are very large. One-half of our vessels sell their fish in Portsmouth. George told me to-day that they got 10,000 pounds at one haul instead of 8,000 pounds. One dory got 84 fish. Schooner Phantom arrived to-day with 8,000. It went down the same day that George did. So the nets catch more fish than the trawls, thanks to Professor Baird. The crew made $32 to a share.

GLOUCESTER, MASS., *January* 12, 1881.

The schooner Northern Eagle, Capt. G. H. Martin, has returned from her sixth trip in Ipswich Bay. She got 35,000 pounds in four nights, which is three times as much as the trawlers obtained in the same time.

On the morning of January 19 she got 18,000 pounds in one haul. The schooner Christie Campbell had 10,000 hooks set abreast of the nets at the same time, and caught 37 fish. Captain Martin sold his catch to-day at $1.40 a hundred pounds. The following vessels are having nets made: Schooner Emma L. Osier, 18 nets 50 fathoms long; schooner Defiance, 15 nets; schooner David A. Osier, 18 nets. Some of the men that are going in small boats are knitting two nets each. John Pew has a vessel which is going to carry nets to the Grand Banks. Captain Wheeler, of the schooner Defiance, went to Boston yesterday and ordered 900 fathoms. I think that next month all the boats will have nets. The net company ought to give Captain George a gang of nets. It has more orders than it can fill in three weeks. The glass-blowers told Captain Wheeler that they had 2,500 balls to blow. There were five masters of vessels over to see Captain Martin to find out how the nets are set and how they are rigged. Some think that if all have nets they will not get so many fish. It is suggested that the bait on the trawls toles the fish. The complaint is made that if all have nets of 10 inch mesh they will not get any small fish to cut up; so much the better; the large ones will fetch a higher price. Captain Martin thinks the nets are good things, because they give the small fish a chance to grow. He does not think they will hurt the fishing as much as the trawls. In the nets they get all that "mesh," while on the trawl the fish often break the gangings and go off with the hooks in their throats, which soon kill them.

Captain Martin in six trips has landed 120,000 pounds of fish, which were all sold round. He did not have a hundred pounds of small ones; while some of the trawlers got one-third small. The bait-bill of some of the vessels that started when he did is $380. The men on the herring vessels swear at the nets because they think none of the shore boats will buy bait after this month.

GLOUCESTER, MASS., *January* 22, 1881.

The vessels with cod gill-nets are doing well. The schooner Defiance, with eighteen nets, got 45,000 pounds in seven nights. The schooner Morrill Boy, with twelve nets, got 24,000 pounds in five nights. The schooner Emma S. Osier, with eighteen nets, got 54,000 pounds in ten nights. The Northern Eagle got 12,000 pounds in three nights. There are several more which I have not heard from; they do not bring their fish to Gloucester, as they can get a better price at Portsmouth, and they do not have to come for bait. It bothers the fishermen why they cannot get big fish on the trawls. The average weight of the trawl fish last week was 10 pounds; of those caught in nets, 22½ pounds.

There are are now 10 vessels altogether which have nets. The weather during the past week has been cold and foggy. There are in Gloucester 200 nets. When they all are in use we shall hear of good work. I am watching to get some spawn. I think some of the boats

will be up Sunday. One vessel from Portsmouth and three from Swampscott have nets. The schooner Barbara Frietchie has gone to the Western Bank, carrying three nets; and schooner Commodore Foote is going there with the same number. Some of the vessels tried floats made of cork boiled in pitch, which filled with water in two nights. One had hers of sheet-iron, but they flattened together. Now, all have provided themselves with glass ones. On Monday they got 2½ cents per pound for fish in Portsmouth. The wind is blowing fresh from the northeast to-day, and the nets cannot be hauled.

GLOUCESTER, MASS., *March* 2, 1881.

The vessels with cod gill-nets have failed to get fish during the past week, as the weather has been too rough. Some of them hauled their nets this morning, getting from 2,000 to 3,000 pounds, which sold at 5 cents per pound. Schooner George Clark, jr., has returned from the Western Bank. One of her 3 nets was out two days in 60 fathoms of water and caught only 19 fish. The weather was rough, and I do not think the net was set right. The sinkers were too small; it takes 4 pounds to sink one ball, and some of the sinkers she had weighed only 2 pounds. Schooner Commodore Foote set 2 nets in 50 fathoms of water on Western Bank, and got 50 large fish to a net. Next month when the fish get into shoaler water the nets will do well. I think they would be successful in 60 fathoms if they were set right. George [Capt. George H. Martin] is going to the Western Bank next month and will give the nets a fair trial. He will take 32 of them with him.

Finback whales are plenty on the coast. Three were shot at Provincetown; there are many in Ipswich Bay, and the fishermen say there are plenty of them on George's. There is a great school of herring on George's, which are of very large size. The weather is very cold. For two mornings the thermometer has been at 19° at six o'clock. There are two Gloucester vessels at Grand Manan. I think they will each get a load of frozen herring. A small vessel arrived this evening with 50,000.

We shall hear more about the nets next week when other Western Bankers get home, and then I will write again.

GLOUCESTER, MASS., *March* 6, 1881.

The spawn I sent you this morning was the best I could get. There were 7,000 pounds of codfish here this morning, but there was only a bucket of spawn from the whole. They were nearly all large, ripe, male fish. Captain Gill says that on Wednesday he carried 6,000 pounds of cod to Portsmouth, which were half females. I never saw all the fish males before at this time of the year. I opened 22 that came out of a net yesterday, and every one was a male. I think the female fish will come back as soon as the sea goes down. Schooner Martha Jane had 6,000 pounds of codfish. Her captain gutted his fish and sent them to Boston. He says they were all males. The fishermen think it strange that

the female fish have gone in so short a time. All the vessels that carry nets are at home mending them, as they were badly torn during the last storm. Almost all the nets went adrift, but were all recovered. Their drifting was caused by the strong tide resulting from the freshet in the rivers. The men like the nets first rate. Herring are selling to-day for $1.25 per hundred. It comes hard on the trawlers, but it does not affect the netters. I think that this week, when the latter all get to work, we shall hear of good fishing with the nets. There will be 180 nets down this week in Ipswich Bay.

GLOUCESTER, MASS., *March* 15, 1881.

There were 9 vessels fishing with cod gill-nets in Ipswich Bay last week. They carried 21 nets each, and averaged 20,000 pounds of nice cod to a vessel. The trawlers had to leave the bay, as they could not get bait. Some of them bought razor-clams and tried them on the trawls. Several got 7,000 pounds as the result of the week's fishing. Their fish were of small size, but those taken in the nets were large. The stormy weather has hurt the nets. Two mornings in last week the water was too rough for them to be hauled, and, lying on the bottom with fish in them, they were badly torn. A new school of cod entered the bay last week. A quarter of them were females, and large. If the weather is good this week the netters will do well. All the large trawlers have quit; but so much the better for the netters. They are getting nets all along the eastern shore.

GLOUCESTER, MASS., *March* 23, 1881.

The vessels with cod gill-nets did not do much the last week. The weather was too windy. They under-ran their nets twice, and found good fishing. The fish were large, and half of them were females. The weather has been cool the last two days, and the wind has been blowing hard from the northwest. Poor chance for the netters.

I suppose you have heard all the news about the mackerel that Sol. Jacobs carried in to New York. He caught them 40 miles southeast from Chincoteague. The mackerel are only 9 inches long, but they are plenty and extend from the southeast part of La Have Bank to as far south as Chincoteague. On the day when Sol. Jacobs got his mackerel there were a great many schools seen, and if it had been fine weather he could have gotten the vessel full. A telegraphic dispatch has just come telling of the loss of the schooner Lizzie K. Clark. She was bound south after mackerel, and was upset in a squall. All the members of the crew were saved.

GLOUCESTER, MASS., *March* 24, 1881.

The net fishing in Ipswich Bay is almost over. They have not caught any fish there this week. The Northern Eagle got 500 pounds on Saturday night and 800 pounds on Sunday night. George [Capt. George H. Martin] is going to the Western Bank. The vessels that carried nets

there did not give them a fair trial. When George gets back we shall find out what can be done with them on that ground. A large school has been on the Western Bank. Some of the fishermen think that as soon as the boats left off trawling the fish went away, for they suppose that the bait which comes off the trawls attracts them. Most of the netters are going to the offshore grounds. No cod have yet been caught in Boston Bay this spring. The haddock vessels have done well this winter. If George gets a good trip on Western Bank a good many others will go there with nets. They all want some one to go first. Hope he will do well.

GLOUCESTER, MASS., *April* 18, 1881.

Ten sail of vessels have put their cod gill-nets ashore. There are fish in Ipswich Bay, but they cannot be caught with nets. Two boats caught, with trawls, 25,000 pounds of fish in five nights and days. The highest catch in nets was 3,000 pounds in the same length of time. Nets were set at the same place where the trawls were, but took no fish. On Tuesday night the schooner Anna Bell took 5,000 pounds of fish on trawls. The schooner Rising Star, with 24 nets, got 26 fish. The netters had to give it up. It works the same way off Gloucester. Some of the small boats had 2 nets set and got no fish. Trawls set in the same place took 300 and 400 pounds. Schooner Annie Fey set 6 nets on Western Bank one night and caught 1 fish. Perhaps the nets were not set right. I am sorry it has worked so. The men have been to a good deal of expense. They spent a week tanning and tarring their nets for summer fishing. The vessels have all taken their trawls. The men say: "D—n the nets! All they are good for is three months in winter, when the fish are spawning." When the Northern Eagle returns from the Western Bank we may hear a better report. If you can throw any light on the subject, please write and let me know. They ask me about the matter, and I do not know what to say. The cod which they are getting in Ipswich Bay are large, but different from the ones they get in winter. What few are taken in the nets are dissimilar to those hooked on the trawls, and look like the winter fish. The fish here now do not travel by nights; if they did, they would go into the nets. I do not think the nets will be used again until next winter, unless George does well on Western Bank.

GLOUCESTER, MASS., *April* 22, 1881.

NOTE.—For a continuation of Captain Martin's reports on the cod gill-net fishing, see pages 343–345 in Volume I of this Bulletin for 1881. A full description of the nets and of their use, together with the history of their introduction by the United States Fish Commission, written by Captain Collins, may be found in the same volume, pages 1–17, with 12 illus rative plates.—C. W. S.

11.—NOTES ON THE COD GILL-NET FISHERIES AT GLOUCESTER, MASSACHUSETTS.—1882-1883.

By S. J. MARTIN.

[From letters to Prof. S. F. Baird.]

In 1878, 1879, and 1880 the vessels did well with cod-nets. Last year they did but very little with nets. The reason is that there were no fish inshore. The result was the fishermen thought nets would never be used again, and some sold their nets for drink and some let them rot. Some who had nets in the last part of the winter took care of them. This winter the tide has turned. Six weeks ago the haddock catchers caught from 15,000 to 18,000 pounds of large codfish on the western part of Cashe's in 60 fathoms of water, and these fish came inshore to spawn. When the spirling were here the boats went out on the rocky spots of the fishing ground and caught some large codfish, say 200 pounds a day; but the spirling failed, and when the boats went out with clams they caught no fish. Captain Gill three weeks ago went out and set 8 old cod nets and caught 1,500 pounds of cod, but some of the nets were so rotten that the fish went through them. Then he bought 12 nets from the Banks fishermen, and since that time he has landed 35,000 pounds of large cod. This is doing well when there is little or no bait. At that time there was one boat from Gloucester and one from Rockport; to-day there are ten sail from Gloucester and two from Rockport. All the nets that were in Gloucester have been bought up and some new ones brought from Boston. The schooner Rising Star, after fishing 10 days, has stocked $1,100. A boat with 3 men went out, set 7 nets 4 miles from the shore, and came in this morning with 5,000 pounds large cod for one night's fishing. All the boats are doing well, and much work will be done this winter with cod gill-nets. Cod sold to-day at 3 cents a pound. The boat Morrill Boy has made $100 a man.

GLOUCESTER, MASS., *December* 6, 1882.

The cod gill-net fishing has been a great success so far this winter. There have been landed at Gloucester 180,000 pounds of large cod which had been caught in nets. It is five weeks since they began to use nets. There are 20 boats, large and small, fishing with nets, and 195 nets are in use at present. A year ago all the fish caught in nets were obtained in Ipswich Bay, but this winter the greater part of the fish have been caught off here on the rocky bottom. The fish are large, averaging 21 pounds. Seven-eights of those caught are males. There are two vessels that have made $220 to a share. These cod bring a good price, being sold at 3 cents a pound.

GLOUCESTER, MASS., *December* 20, 1882.

The net fishermen have succeeded well in Boston Bay this winter. Six hundred thousand pounds of fish caught in this bay have been landed

at Gloucester. The most successful vessel has made $380 since November 17; this was with 5 men and 16 nets. The fish all left the bay in one night. The net fishermen are getting ready to fish in Ipswich Bay. Two boats which are now there are doing well. The fish sometimes remain there until April 1. The total value of the fish landed at Gloucester by the netters, thus far, is $15,000; 70 men and 140 nets have been engaged. The outlook for a prosperous winters' work is good.

GLOUCESTER, MASS., *January* 11, 1883.

There are 10 vessels in Ipswich Bay using cod gill-nets. They are using 15 nets to a boat and are doing well. During the last 20 days they have landed at Rockport and Portsmouth 230,000 pounds of large cod. Some of the boats have made $110 to a share, with 8 men to a boat. The fish are in one small spot, and 150 nets are set on a spot of ground half a mile long and quarter of a mile wide. The nets are often set across each other, so that one man was obliged to haul 7 nets in order to get his own. Those on top get the most fish.

GLOUCESTER, MASS., *February* 6, 1883.

Net fishing is about ended for this winter; not more than two boats are now fishing with nets. The reason why the boats took up their nets so soon is because the nets were worn out, and they do not want to get new ones. Fish have been scarce during the past week, and the time for net fishing is short. The fish in Ipswich Bay are large. The schooner Blue Jay was in Rockport yesterday with 135 fish which weighed 4,134 pounds; these fish sold for 5½ cents a pound. I think the boats that have nets will do well; 5,000 pounds now is as good as 15,000 pounds in 1881.

GLOUCESTER, MASS., *February* 24, 1883.

The fishing with cod gill-nets in Ipswich Bay has been good during the last ten days. Some of the boats landed as many as 15,000 pounds last week after two nights' fishing. All the boats which took their nets up have gone with them to Ipswich Bay. The fish are very large and full of spawn. The crew of the boat Martha Jane shared $92 apiece after fishing 10 days. This was with 8 men and 4 dories.

The net fishing for cod is done for this year. The amount of fish landed here which were caught in nets this winter is 2,335,000 pounds. These fish were weighed as they came from the water. During the months of November and December, when fish were plentiful, there were not many boats with nets, but in the latter part of the winter there were 21 boats fishing with cod gill-nets. If the whole fleet had used nets in the first part of the winter the catch would have been much larger. The number of vessels fishing with nets is 21. Six dories with cod-nets fishing out of Hamilton, with 3 nets and 2 men to a dory. Number of nets used this winter, 420; men engaged, 180. The nets are 50 fathoms long. The weather this winter has been rough for net fishing, the nets not being hauled more than two-thirds of the time. Three

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boats have nets down, but they have not been hauled this week. The nets are all used up. If the fish remain in the nets over twenty-four hours they are scaled; the sand fleas take the scales off and suck the blood out of the fish. Then they have to be sold for half price.

GLOUCESTER, MASS., *March* 25, 1883.

12.—THE AMERICAN PURSE-SEINE SUCCESSFUL IN THE HERRING FISHERIES OF SWEDEN.

By S. J. MARTIN.

[Letter to Prof. S. F. Baird.]

You will probably be interested to know that a purse-seine has been successfully used in the herring fisheries of Sweden, near Gottenborg. My son, Capt. George H. Martin, informs me that Andrew Swinton, who formerly fished from Gloucester in schooner Northern Eagle, returned home to Gottenborg in 1879, and writes to William Swinton, his brother, now living in Gloucester, to the following effect: "In the spring of this year (1882) I bought some twine and had a purse-seine made here in the same style as the Gloucester seines, and went off in a small craft to try it on the herring in this vicinity. I am doing first rate, and think the purse-seine can be used to great advantage in these waters. This is the first purse-seine that I know of ever being used on this coast." I can get more facts when William Swinton returns from a fishing trip.

GLOUCESTER, MASS., *October* 17, 1882.

I have seen Mr. Swinton and learned what I could concerning the use of the purse-seine in Sweden. This Andrew Swinton is a brother of the William Swinton who lives in Gloucester. He went mackerel fishing from this port for five years with seines; but went back to Sweden three years ago and settled there. In Sweden it seems that they catch most of their herring with drag-seines; but for the three years last past the herring have kept so far off shore that the fishermen could not reach them well with a drag-seine. Last winter Mr. Swinton had a purse-seine made, which was 840 feet long and 90 feet deep. This seine excited much interest among the fishermen. The first time it was set 50 barrels of large herring were caught. Mr. Swinton does not state how many herring he has caught during this summer, but says that he did well, and has made three times as much as any other fisherman in Gottenborg. He states also that next year there will be three more purse-seines used.

GLOUCESTER, MASS., *November* 10, 1882.

13.—NOTES ON THE FISHERIES OF GLOUCESTER, MASSACHUSETTS.

By S. J. MARTIN.

[Letters to Prof. S. F. Baird.]

The receipts of fish at Gloucester during the month of July were as follows: 200 fares salt mackerel, 62,734 barrels; 5 fares fresh mackerel, 675 barrels; 78 fares from George's Bank and vicinity, with 1,051,000 pounds cod and 114,000 pounds halibut; 40 fares from Western Bank and Banquereau, with 2,105,000 pounds cod and 40,200 pounds halibut; 8 fares from Grand Banks, 870,000 pounds cod; 12 fares from Grand Banks, 625,000 pounds halibut; 55 fares shore fish from Bay of Fundy, etc., with 1,020,000 pounds of mixed fish, one-eighth cod, and the rest haddock, hake, and cusk; 1 fare (500 quintals) freighted from Maine; and 4 fares (2,150 quintals) of cod, etc., imported from Nova Scotia. The schooner Henry N. Woods, 16 men, which had been gone 18 days, brought in the largest fare of salt mackerel—560 barrels.

GLOUCESTER, MASS., *August* 1, 1882.

The receipts of fish at Gloucester during the month of August were as follows: One hundred and seventy arrivals salt mackerel, 43,328 sea-packed barrels; shore mackerel catch, 75 barrels salt, and 370 barrels fresh; eighty-three arrivals from George's and Le Have Banks, with 1,057,000 pounds salt cod, and 50,000 pounds fresh halibut; thirty-six arrivals from Western Bank and Banquereau, with 1,939,000 pounds salt cod, and 9,000 pounds salt halibut; nineteen arrivals from Grand Banks, with 2,540,000 pounds salt cod, and 9,000 pounds flitched halibut; one arrival from the Gulf of Saint Lawrence, with 30,000 pounds salt cod; five arrivals from the cape shore, with 265,000 pounds salt cod; nineteen arrivals from Grand Banks, with 875,000 pounds fresh halibut; thirty-five arrivals after shore trips—vessels, 879,000 pounds (mostly hake), shore boats, 352,000 pounds (mostly hake). Also there were freighted from Maine 210,000 pounds and 1,550 quintals (mostly hake and cod), and imported from the Provinces 282,000 pounds and 200 quintals of dry fish, and 100 barrels of mackerel.

GLOUCESTER, MASS., *September* 4, 1882.

The mackerel fleet did poorly during the last week. The mackerel which were caught were taken among the rocks. Two vessels on Friday and Saturday last caught 200 barrels close to Matinicus Rock. One of the Portland vessels caught 275 barrels on the southeast part of George's Bank. Twenty-one sail were in Gloucester from mackerel fishing last Monday. The average catch was 150 barrels, and some of the vessels had been gone 5 weeks. Horse-mackerel are very abundant all along the eastern shore. The schooner Dreadnaught set a seine around what they

supposed to be a school of pollock, but it proved to be a school of horse-mackerel; 50 of these tore the seine all to pieces. The fish weighed 35 pounds apiece, and were what the fishermen call bonitoes. I think the school of mackerel that was on Brown's Bank has gone over to George's Bank. Some mackerel have been caught on the shore of Nova Scotia. The cod fishermen report mackerel on the southeast part of George's. Large herring are abundant on the eastern shore. I think the mackerel caught on the eastern shore came from the Bay of Fundy. Mackerel sold to-day at $2 a barrel, with the barrel. No codfish are on the shore grounds. The small vessels are doing well catching hake all along the eastern shore; 85,000 pounds were landed to-day from 4 vessels which had been gone 10 days. Hake sell out of the vessel for $2.30 per hundred pounds. The sounds and livers make them $3 25 per hundred pounds. George's cod sold to-day for $5 a hundred, green out of the vessel; dried George's cod sold for $7 a quintal; dried Grand Banks cod sold for $6.25 a quintal. All kinds of dried fish are high.

GLOUCESTER, MASS., *September* 6, 1882.

The weather for the past four days has been too windy for catching mackerel; but yesterday afternoon, after the wind died away, the mackerel were seen schooling close to the shore from Thatcher's Island to Eastern Point. There were mackerel, alewives, and herring, so mixed together that to get 20 barrels of mackerel one must also catch 20 barrels of alewives and 20 barrels of herring. The alewives and herring are found in unusual numbers near the shore from Gloucester to Booth Bay. The fishermen do not know what keeps the mackerel so near the shore. Mackerel are selling at higher prices to day—$10 a barrel, with the barrel. The vessels with large seines do not get much chance to get mackerel, while the market boats with shoal seines do very well. The shoal seines are 7 fathoms deep, the large ones 25 fathoms deep, and so the 7-fathom seine has all the advantage in shoal water. Swordfish are numerous on Jeffrie's Bank. They are higher to-day than ever I knew them to be before, selling at $10 a barrel, salted. The vessels at George's Bank, Western Bank, and the Grand Banks are doing well. The schooner Hattie L. Newman arrived from Greenland with 150,000 pounds flitched halibut and with 100,000 pounds salt cod caught on Flemish Cap before going to Greenland. The Greenland vessels will make big stocks of salt halibut, which will bring about 7¾ cents a pound.

GLOUCESTER, MASS., *September* 18, 1882.

There has been but little mackerel fishing during the past week; the wind has been northeast and the sea was too rough for seining. On the 20th instant five barrels of large herring, full of spawn, were caught. The spawn was ripe and running out of the fish. This is the earliest that spawning herring have been caught in the harbor for fifteen years; but fifteen years ago some were caught here on September 15. For the past three years they have come from October 5 to 15, and in these three

years the temperature of the water when they came was 35° F., while to-day it is 50° F. I find a great difference in the spawning times of schools of herring. At Magdalen Islands they spawn in April, at Grand Manan about September 1.

The herring are not so large at Magdalen or Grand Manan as those which come here to spawn. When the fishermen catch a large herring with a white-tipped nose they know that the spawning herring are coming and put down their nets, for the large spawning herring have white tips on their noses.

The shad went down the coast with the alewives and mackerel, and it seems they are coming back with them. The schooner Finance recently caught 50 barrels of alewives and 2 barrels of mackerel, and among them were 3 barrels of large shad.

I will also refer to the sun jelly [a kind of sea-nettle]. I have not seen one of these in the harbor this summer. Last summer there were thousands of them here, but now I cannot find a fisherman who has seen any either in or out of the harbor. It seems that they have left the coast this season.

Mackerel are selling at a highprice to-day—$11 a barrel, including the barrel. Pollock have made their appearance; one vessel caught 25,000 pounds in three days on Jeffrie's Bank. These sold, fresh, at 4 cents a pound. Pollock are a fortnight early this year, and there is no other fish in the market. The harbor now is full of vessels, there being 350 sail, mostly fishing vessels in for shelter.

GLOUCESTER, MASS., *September* 28, 1882.

The receipts of fish at this port for the month of September were as follows: mackerel, 131 fares, 21,859 sea-packed barrels; George's Bank, 55 fares, 85,200 pounds salt fish, 23,100 pounds fresh halibut; Western Banks, 50 fares, 2,447,000 pounds salt fish, 57,400 pounds fresh halibut; Grand Banks, 12 fares, 575,000 pounds fresh halibut; Grand Banks 13 fares, 2,055,000 pounds salt fish, 10,200 pounds fresh halibut; Greenland, 4 fares, 540,000 pounds salt halibut; Flemish Cap, 2 fares, 210,000 pounds salt fish; Le Have Bank, 5 fares, 225,000 pounds salt fish; Bay of Fundy, 21 fares, 475,000 pounds salt hake; Maine coast, 8 fares, 59,000 pounds fresh pollock, 95,000 pounds salt hake; off Cape Ann, 112,000 pounds salt hake; freight from Maine, 4,650 quintals mixed salt fish; imported from the British Provinces, 1,070,000 pounds salt fish, 3,500 pounds salt halibut.

GLOUCESTER, MASS., *October* 2, 1882.

The amount of fish landed in Gloucester during October is as follows: mackerel, 17,692 barrels; herring, 3,700 barrels; George's cod, 601,000 pounds; George's halibut, 125,500 pounds; Western Bank cod, 713,000 pounds; Grand Banks cod, 760,000 pounds; Grand Banks halibut, 591,000 pounds; Greenland salt halibut, 80,000 pounds; Greenland cod, 60,000 pounds; pollock 1,267,000 pounds; Cape shore cod, 53,000 pounds;

Bay of Fundy cod, 30,000 pounds; shore cod, 20,000 pounds; Le Have Bank cod, 112,000 pounds; Cashe's cod, 39,000 pounds; cod caught on Seal Island grounds, 15,000 pounds; Western Bank halibut, 7,000 pounds; hake, 670,780 pounds; haddock, 34,000 pounds; cusk, 143,630 pounds; mixed fish, 10,840 pounds; bay mackerel, 47 barrels; salt water herring, 500 barrels; fish oil, 10 barrels; sounds, 11 barrels.

GLOUCESTER, MASS., *November* 3, 1882.

I send you the amount of fish landed at Gloucester in the month of November: mackerel, 6,185 barrels; herring, 211 barrels; George's cod, 398,000 pounds; George's halibut, 19,500 pounds; Western Bank cod, 353,000 pounds; Western Bank halibut, 14,300 pounds; Grand Banks halibut, 164,000 pounds; Grand Banks hake, 400,000 pounds; haddock caught on the cape shore and brought from Boston, 516,000 pounds; dried fish by freight from Maine, 500 quintals cod, 200 quintals haddock, 2,900 quintals hake, 1,535,000 pounds pollock; mixed fish caught on the shore grounds, 463,000 pounds, being cod, hake, and cusk in equal parts; cod caught with hand lines on the rocks 4 miles from shore, 17,000 pounds. Fish caught in cod gill-nets, 34,300 pounds.

GLOUCESTER, MASS., *November* 4, 1882.

The mackerel vessels are all home—the last one came yesterday—and they are all hauled up for this season. The mackerel fishing has been a great success this year. The largest stock that ever was made out of Gloucester on any kind of fish has been made by the schooner Nellie N. Rowe. (See the figures below.) Pollock have been very plenty this fall; they have not been so abundant since 1862. To-day there are 200,000 pounds of pollock in port; this is one day's fishing with 30 boats, averaging 9 men to a vessel; and to-night at dark probably there will be 400,000 pounds, and the vessels are not half in. As many pollock have been carried to Maine as have been landed here. There have been 800,000 pounds landed at Rockport. The fishermen sell them for $1 a hundred pounds, round. Three boats have set cod gill-nets. Last week the schooner Quickstep, of Rockport, caught 22,000 pounds of large cod with twelve 50-fathom nets. The boats are doing well on the rocks catching codfish. The winter school is coming on. The amount of hake landed here this year is very great. The first snow of the season came to-day. I now give two extracts from the newspapers:

"TWO ROUSING MACKEREL STOCKS.—Two of the largest mackerel stocks ever landed at this port or in New England have been made by the schooners Nellie N. Rowe, Capt. Eben Lewis, and the Edward E. Webster, Capt. Solomon Jacobs, the past season, comprising eight months of time actually employed. The net stock of the Rowe was $35,537, and of the Webster, $34,229. The average share of the Webster's crew was $959.75, and the steward, Mr. Warren Fowles, with his extra pay of $160, made his season's work $1,129.75."

"A LARGE POLLOCK FLEET, including many Maine vessels, and one from Nova Scotia, have been busily employed off this port for the past six weeks, meeting with unprecedented success. The amount of pollock landed at this port this season has been 2,094,100 pounds (against 481,000 pounds to this date last year), and nearly, if not quite, as large an amount has been taken to the eastward by the fleet from that section."

GLOUCESTER, MASS., *November*, 17, 1882.

The fishing business has been prosperous in all its branches this season at Gloucester. Some of the largest stocks that were ever made were made this year. There have been 50 new vessels added to the fleet since the 1st of March; the vessels that have been built will average 85 tons, and cost, when ready for sea, $9,000 apiece. The firms are selling off their old vessels and having new ones built. There is nothing doing on the rocks, for the fishermen cannot get bait to fish with hand lines. There are four boats fishing with cod gill-nets, and they are doing well. The sperling is all gone. Haddock catchers have to go to Grand Manan after bait. There will 12 sail go to Newfoundland after frozen herring, and 20 sail to Grand Manan after frozen herring. The pollock fishing has been very successful this fall, but it is now ended. As near as I can find out, there have been 4,000,000 pounds of pollock caught, weighing the fish as they came out of the water. I add a newspaper article on—

"THE MACKEREL FISHERY.—The mackerel fishery for the present season has closed, and as a whole it has proved one of the best, and perhaps the very best, season for this branch of the fisheries that Gloucester has ever known. Although a few of the vessels have not made satisfactory stocks, yet the majority have more than fulfilled the expectations of those interested in them, and several of the fleet have stocked amounts which have never before been reached in the history of the mackerel fishing business. To do this required hard and constant work on the part of the fishermen, and many of them have shown an energy and perseverance worthy of the highest commendation. The present manner of fishing with seines makes the possibilities of large stocks more dependent on the ability and energy of the captains than the old method of hand-line fishing. It requires experienced and vigilant men on the lookout both by day and by night, watching for schools, and upon this constant watchfulness, in a great measure, their success depends. The use of the recently patented pocket is a great help in saving the fish when big hauls are made, keeping them in good condition until they can be properly taken care of by the crew, and thus helping to increase the catch of the vessel. Capt. Solomon Jacobs, schooner Edward E. Webster, claims to be 'high line,' he having made a net stock of over $34,000 this season.

"Captain Jacobs has stocked upwards of $75,000 during the past

three years' mackerel-fishing, the time actually engaged being eight months each year, as follows: 1880, $16,700; 1881, $24,600; 1882, $34,229; total $75,539. Capt. Eben Lewis, in schooner Nellie N. Rowe, is probably second, but as no reliable statement of his stock has been made and it is estimated by the fishermen at figures ranging from $27,000 to $34,000, it is difficult to tell what his stock really is. The following vessels have stocked upwards of $15,000 in the mackerel fishery this season from this port:

"Schooner Edward E. Webster, Capt. Solomon Jacobs; net stock, $34,229; crew shared $969.75.

"Schooner Nellie N. Rowe, Capt. Eben Lewis; no definite figures given.

"Schooner Col. J. H. French, Capt. John Chisholm; net stock, $20,000; crew shared $615.

"Schooner Leona, Capt. Willard Pool; net stock, $19,715.72; crew shared $582.

"Schooner Carl Schurz, Capt. Jed. Warren; net stock, $15,609; crew shared $468.08. Previous to the 6th of June the Schurz was engaged in fresh fishing, and her total stock since the first of the year is $23,222, the crew sharing $733.86.

"Schooner John D. Long, Capt. Charles Hardy; net stock, $18,500; crew shared $571.

"Schooner Helen M. Crosby, Capt. Joseph Swim; net stock, $18,020; crew shared $596.17.

"Schooner Ivanhoe, Capt. James Crawley; net stock, $16,942; crew shared $525.

"Schooner Golden Hind, Capt. Solomon Reed; net stock, $16,323; crew shared $504.31.

"Schooner John S. McQuin, Capt. Henry Coas; net stock, $16,035.57; crew shared, $517.11.

"The stock of mackerel in first hands is much lighter than last year, and prices, which have been high and well sustained through the season, will continue to increase, especially when the trade opens after the holiday season."

GLOUCESTER, MASS., *November* 26, 1882.

The first cargo of frozen herring arrived last night. There were 200,000 of them, and they sold for $3,000.

GLOUCESTER, MASS., *December* 20, 1882.

The amount of fish landed here during December is as follows: Shore fish caught with hand lines from small boats, 20,000 pounds; George's cod, 202,000 pounds; George's halibut, 16,500 pounds; Western Bank cod, 130,000 pounds; Western Bank halibut, 9,200 pounds; fresh halibut from Grand Banks, 177,000 pounds; fresh haddock, 111,000 pounds; cod caught in nets, 565,000 pounds; 200,000 frozen herring.

GLOUCESTER, MASS., *January* 5, 1883.

The following is a report of the fish received here during January, 1883: George's cod, 844,000 pounds; George's halibut, 144,200 pounds; cod from Le Have Bank, 35,000 pounds; halibut from Le Have Bank, 13,000 pounds; halibut from Grand Banks, 199,500 pounds; shore cod caught in gill-nets, 121,000 pounds; herring from Grand Manan, 1,198,000 in number; herring from Newfoundland, 2,180,000 in number; haddock from George's Bank, 685,000 pounds; hake imported from British Provinces, 950 quintals.

GLOUCESTER, MASS., *February* 2, 1883.

The George's vessels are doing well, as a school of large cod came on the bank early in the winter. In past years the middle of February was about the time when the winter school came on George's Bank; but this winter they came in January, and with them came a large school of haddock. There is a good school of halibut for this season. There were nine sail in from George's on Monday, averaging 15,000 pounds salt cod and 4,000 pounds halibut; this is a good showing work for hand-line fishing. These fish are caught on the eastern part of George's, in from 40 to 60 fathoms of water, on hard bottom. The cod fishermen on George's Bank complain that the haddock fishermen injure the cod fishing. When the cod fishermen are at anchor and succeeding, if the haddock fishers set their trawls near by this frightens away the cod. Besides, the haddock gear is of small size, and if a large cod gets on a trawl the fishes break the snood gear and leave the hook in the fish; and so the fish dies and lies on the bottom. And then the haddock catchers dress their fish on the bank and throw the gurry overboard, and this drives the cod away.

GLOUCESTER, MASS., *February* 6, 1883.

The vessels fishing on George's are doing well. There have been 10 arrivals from George's during the last week, with an average of 20,000 pounds cod and 3,000 pounds halibut to a vessel. The cod are split and salted on board the vessel and sell here at 4½ cents a pound; halibut have sold all the week for 12 cents a pound. The halibut catchers have done poorly; 2 arrived this week with 20,000 pounds each, after having been gone from home six weeks. The haddock vessels have been fortunate during the past week. Some of the vessels had 75,000 pounds, after two days' fishing on George's; one vessel stocked $2,100 in two days' fishing. Five vessels arrived with herring; four from Grand Manan, one from Newfoundland. 1,295,000 herring were brought in this week. There is no lack of bait.

GLOUCESTER, MASS, *February* 24, 1883.

The report of fish landed at Gloucester during the month of February is as follows: George's cod, 1,124,000 pounds; George's, halibut, 184,900 pounds; Western Bank cod, 140,000 pounds; Western Bank halibut, 37,000 pounds; shore fish caught in nets, 18,000 pounds; Grand Banks

halibut, 112,000 pounds; haddock, 49,000 pounds; Newfoundland frozen herring, 4,400,000; Grand Manan frozen herring, 4,035,000. There have been imported from Canso, N. S., 28,000 pounds cod, 630 barrels mackerel, 450 barrels pickled herring. The arrivals last month were as follows: Eleven sail from Newfoundland, with frozen herring; 20 sail from Grand Manan, with frozen herring; 59 sail arived from George's, with cod; 5 sail from Western Bank, with salt cod; 6 sail from the Grand Banks, with fresh halibut; 1 from Canso, with mackerel, herring, and cod. There were 2 arrivals with haddock; and 5 sail came in from Ipswich Bay.

GLOUCESTER, MASS., *March* 2, 1883.

There have been 37 arrivals from George's Bank during the last week, averaging 25,000 pounds cod and 2,000 pounds halibut to a vessel. The fish caught on George's are caught in shoal water of 18 to 25 fathoms; the fish are large and full of spawn. The first fish were caught on the eastern part of the bank in the month of January, in about 60 fathoms of water. These fish contained no spawn. Those now caught are full of spawn, and are taken on the western part in 20 fathoms. There have been four arrivals from the Western Bank in the last week, with good fares—40,000 pounds salt cod, and 4,000 pounds halibut to a vessel. Six cargoes of frozen herring have arrived during the last week, average 250,000 to a vessel. The halibut vessels have not done much—nothing in the last week. The haddock are plentiful on George's Bank. I have known vessels to catch 70,000 pounds in two days, and make the round trip in a week. Some vessels went out Tuesday and were back Sunday with 60,000 pounds. They caught these on the western part of George's, in 20 fathoms of water. The oldest haddock are full of spawn. The oldest haddock catchers say that they never saw them so numerous. There is a large fleet of vessels in the harbor, and they will not go out until Monday, being afraid of Wiggins's storm.

GLOUCESTER, MASS., *March* 6, 1883.

The George's vessels are doing well. There were 12 arrivals last week, averaging 30,000 pounds of split fish, and 500 pounds of halibut to a vessel. Two vessels arrived from Western Bank with 65,000 pounds of cod to a vessel. Four came in from Grand Bank with fresh halibut, 25,000 pounds to a vessel. Five sail arrived from Grand Manan with 838,000 frozen herring. Twenty-three vessels sailed southward after mackerel, and 40 more will sail in the course of ten days. Fifteen sail have gone south from Portland and 5 from Southport for mackerel. There will be 140 sail after mackerel.

GLOUCESTER, MASS., *March* 25, 1883.

The following is a report of the amount of fish landed here in the month of March: George's cod, 1,547,000 pounds; George's halibut, 77 500 pounds; Western Bank cod, 435,000 pounds; Western Bank

halibut, 21,150 pounds; Grand Banks halibut, 368,000 pounds; haddock, 225,000 pounds; cod caught in gill-nets, 12,000 pounds; frozen herring brought from Grand Manan, 4,730,000 pounds.

GLOUCESTER, MASS., *April* 3, 1883.

Since the 1st of April, 45 sail of vessels have arrived from George's, landing 1,350,000 pounds salt codfish, 22,500 pounds fresh halibut. During the same time there have arrived 4 sail from Western Bank with 235,000 pounds salt codfish and 6,000 pounds of halibut. Ten sail from George's Bank, with haddock, landed 436,000 pounds. Three sail from Grand Manan arrived with 320,000 frozen herring. One vessel from Grand Bank brought 30,000 pounds fresh halibut. Twenty thousand pounds shore fish have been landed.

Gloucester now has 74 vessels south for mackerel; 56 vessels on George's for codfish; 42 vessels on the Western Bank after codfish; 23 vessels after fresh halibut; 15 vessels after haddock; 30 sail of shore fishermen, and 22 small boats and dories carrying one man each.

GLOUCESTER, MASS., *April* 10, 1883.

During the past week there have been 55 arrivals from the fishing grounds, 31 from George's Bank, and 23 from Western Bank. The George's vessels last week averaged 25,000 pounds salt cod to a vessel and 500 pounds halibut to a vessel. The Western Bank vessels averaged 50,000 pounds salt codfish and 4,000 pounds halibut to a vessel. One vessel from the Grand Banks had 20,000 pounds fresh halibut. Halibut are reported scarce. The shore boats have not caught any fish. No bait inshore. The bait has gone to eastward. There have been herring caught on Jeffrie's Bank. There are alewives in Vineyard Sound. Most of the vessels go there after bait. Two boats got alewives at North Truro yesterday. Halibut are plenty on the Western Bank in some places. Halibut sold yesterday at eight cents per pound at wholesale. Schooner M. A. Barton caught 20,000 pounds on codtrawl. Some of the mackerel catchers have done well. There have been 700 barrels more landed this year than last year at this time. The first that came on the coast were small; the last ones caught were large.

GLOUCESTER, MASS, *April* 22, 1883.

The record of fish landed here during the month of April is as follows: George's cod, 2,462,000 pounds; George's halibut, 65,700 pounds; Western Bank cod, 3,317,000 pounds; Western Bank halibut, 156,400 pounds; Grand Banks halibut, 173,000 pounds; George's haddock, 227,000 pounds; shore fish, 12,000 pounds; frozen herring (by count), 390,000. There were 100 arrivals from George's Bank, 70 from Western Bank, 6 from Grand Bank with fresh halibut; while there were 11 arrivals with haddock, 3 with shore fish, and 3 with herring.

GLOUCESTER, MASS., *May* 1, 1883.

During the past two weeks there have been 31 arrivals from George's Bank, with an average of 20,000 pounds to a vessel; 16 from Western Bank, averaging 40,000 pounds each; 19 with fresh halibut from Grand Banks, averaging 30,000 pounds each; and 9 with haddock, averaging 30,000 pounds to a vessel. Yesterday 3 vessels came in with pollock, with a total of 105,000 pounds. These pollock were caught with seines 3 miles off Chatham. Mackerel are very slow in coming northwest this year. Last year at this time they were taken off Sandy Hook; but the farthest north where they have been taken this year is about 35 miles east-southeast of Delaware Breakwater; this was on last Wednesday (May 9). Fifty-four vessels have been in New York this week, with 125 barrels to a vessel. A few scattering mackerel have been caught in the traps at Cape Cod. Herring are very scarce inshore this spring. Last year at this time they were abundant in Boston Bay, and 4 vessels were busy seining them. This year there have been none to catch, either on our coast or on the coast of Nova Scotia. Last week 9 barrels of shad were caught in the traps at Cape Cod. All kinds of small fish are a fortnight late this spring. A school of herring went by to the eastward offshore. They have been seen on Jeffrie's Bank and on Cashe's. Last year at this season there had been 3,000 barrels of salt mackerel landed at New York, while this year only 500 barrels have been landed so far, and only 300 barrels have been landed in Philadelphia.

GLOUCESTER, MASS., *May* 13, 1883.

During the last week 31 vessels have come in from George's Bank with an average of 18,000 pounds of cod to a vessel; 6 have come in with cod from Western Bank, averaging 40,000 pounds each; and 3 from Grand Banks with an average of 5,000 pounds of halibut. There have also arrived 8 vessels from the shore grounds, with a total of 120,000 pounds of haddock. The halibut catchers are not doing much; during the week 3 vessels arrived with 15,000 pounds each, after trying the banks where halibut used to resort and finding them scarce. They went to Burge's, Newfoundland, but found almost nothing, while last year halibut were plenty at Burge's. Small halibut have been plenty on the Western Bank; 2 small vessels got 25,000 pounds each there. These halibut weigh only from 35 to 50 pounds apiece. Herring are scarce; this will cause long trips. Some of the vessels which left Gloucester a month ago—some bound to Grand Banks, some to Cape North—have got no bait even yet. The fishermen's torment, the dog-fish, made its appearance last Monday (May 14). The schooner Blue Jay reports schools of mackerel 25 miles to the eastward of the highlands on Cape Cod. Four vessels have arrived from Chatham with 45,000 pounds of pollock apiece, having caught them with seines. This makes 4 fares (300,000 pounds) of pollock landed at Gloucester this spring; all were caught with seines. Sixty-five thousand large mackerel were caught

in the weirs at Sand Point, Cape Cod. Small cod, from 8 to 20 inches long, are plenty in the harbors.

GLOUCESTER, MASS., *May* 20, 1883.

There have been 62 arrivals here from the fishing-grounds during the past week. Twenty-seventh came from George's Bank, averaging 25,000 pounds salt fish to a vessel; 5 from Grand Banks with fresh halibut, averaging 30,000 to a vessel; 8 with pollock, with an average of 40,000 pounds each; and 14 from the shore grounds, with 20,000 pounds mixed fish to a vessel. The pollock were all caught with seines about 5 miles off Chatham. Last Friday (May 25) pollock were seen in schools on Middle Bank. I never before knew so many small pollock to be about as there are this year; the harbors are full of them. Mackerel are working eastward fast; they have been off Chatham for the past ten days, and are now in shoal water, which is something unusual. There were 100 sail of mackerel catchers off Chatham yesterday. Off Sandy Hook the mackerel are small; here they are large. Ten vessels were in here yesterday with torn seines. The traps at Harwich are full of pogies. There appears to be something that keeps the bait out of Boston Bay. Herring have been caught at Cape Cod during the past 3 weeks; and mackerel had been caught at Sand Point for the same length of time, and a few have been caught here; and some large ones were taken at Kettle Island last night. The fishermen say that there is plenty of feed, called "all-eyes," at Cape Cod, but none in Boston Bay. Mackerel have been caught as far east as Cape Sable, N. S. Herring are abundant at Magdalen Islands. Vessels which went to Cape North after cod are doing well; and the George's fleet is having good success on the western part of George's Bank. There are many traps set this year; 14 are at Kettle Island and Gloucester, and more are being prepared.

GLOUCESTER, MASS., *May* 27, 1883.

The amount of fish landed here during the month of May was as follows: 105 arrivals from George's Bank, with 2,098,000 pounds of salt cod and 68,550 pounds fresh halibut; 41 arrivals from Western Bank, with 1,846,000 pounds salt cod and 194,000 pounds fresh halibut; 26 arrivals from Grand Banks, with 750,000 halibut; 18 arrivals with 357,000 pounds haddock; 33 arrivals with shore fish. Of these last there were 252,000 pounds cod, 126,000 pounds hake, 118,000 pounds haddock, and 98,000 pounds cusk. There were 12 arrivals with salt pollock, a total of 484,000 pounds. These were caught with seines off Chatham. Ten vessels arrived with 358 barrels of salt mackerel; these were taken in weirs in the vicinity of Gloucester. Fifty barrels of fresh mackerel were sold also.

GLOUCESTER, MASS., *June* 4, 1883.

The mackerel fleet has returned from its southern cruise with poor results. Three vessels which left here April 1st did not catch a mackerel. They were hard to catch. One vessel set a seine 74 times, and

yet caught no fish. The difficulty in catching them is charged to the unusual transparency of the water. Captain Cohart says that he lowered a towel to the depth of 20 fathoms, and then could see it plainly. Captain Coas says he could see the purse-weight on the seine when it was 20 fathoms down. They all say it was impossible to seine fish in such water. The large mackerel have gone east, and many are being taken in the weirs at Barrington, N. S. There are small mackerel from Cape Cod to Mount Desert. They are large enough for No. 2's, but are of a different school from the mackerel caught last year.

Pogies are abundant in Boston Bay. Five barrels have been taken in the traps at Kettle Island, and a vessel caught 40 barrels with seine this morning. They are of small size. Last year there was one pogy caught. Yesterday they were schooling close in to the shore of Norman's Woe. Capt. Robert Douglass was in this business twenty years, and he says that he saw as large schools yesterday as he did twenty years ago. It has been so long since pogies were here that people are not prepared to catch them; but some of the small vessels are getting their seines ready. A telegram was received here this morning stating that the weirs at Hyannis, on Cape Cod, were full of pogies.

A large fleet has been at Cape North after cod. They are coming home with full fares. One vessel, which had been gone seven weeks, arrived this morning with 140,000 pounds of cod.

GLOUCESTER, MASS., *June* 6, 1883.

Mackerel are scarce. Vessels have been from Cape Cod to Cape Sable and the Bay of Fundy, and yet found no mackerel. All the large mackerel have passed down the Nova Scotian coast. They have been caught in traps at Cape Sable for the past three weeks. The schooner Polar Wave arrived this morning from the Grand Banks, and reports sailing through mackerel in large schools to the eastward of Sable Island, and that they seemed to be going northward. Those on the New England coast are small. Six barrels of them were sold to-day for $8 a barrel. Last year at this time they would have sold at $4.

Pogies are plentiful. Salem Harbor is full of them, and 150 barrels were seined off the mouth of the harbor. Three large salmon have been taken in the traps at Kettle Island, weighing 22¼, 20, and 18½ pounds, respectively.

Six vessels have left here for Greenland after halibut. On George's Bank fish are scarce at present. The Cape North fleet has returned with good fares, and vessels are doing well on the shore fishing-grounds, catching cod, hake, and cusk. Thirty sail have gone to the Grand Banks after cod, and 3 have started for the Bay of Saint Lawrence after mackerel. A large fleet will go there after July 4 if there are then no mackerel on this coast. Half a barrel of squid was caught in a trap in the harbor here last night.

I inclose the following newspaper item on the steam menhaden fisheries:

"NEW BEDFORD, *June* 5.—The greatest week's work at this time in the season was made by Messrs. J. Church & Co.'s steam fishing fleet last week. The Joseph Church, Jemima Boomer, A. M. Hathaway, and George W. Humphrey nearly every day were loaded almost to the water's edge. The George W. Humphrey brought in 2,200 barrels on Saturday, and the A. M. Hathaway the same number. The catch was made in the Seconet River. The first of last week this gang were fishing back of Long Island Sound, but as the fish worked this way the fleet followed them to Seconet River. The catch last week amounted to about 19,000 barrels, and the Narragansett oil works at Portsmouth are consequently running day and night. While the George W. Humphrey was coming up from below Long Island on Wednesday night, loaded hold and deck, she encountered a heavy sea which swept her deck load of 800 barrels of menhaden into the water, which probably was the means of saving the steamer."

GLOUCESTER, MASS., *June* 14, 1883.

Since my last letter mackerel have come on the coast in considerable numbers. During the past week there have been thirty-five arrivals with 4,840 barrels of salt mackerel. On last Thursday and Friday (June 14 and 15) there were thirty-one arrivals in Boston with 4,000 barrels of fresh mackerel. The mackerel are small—smaller than those of last year. Most of them have been caught from 20 to 40 miles east-southeast of Thatcher's Island. Two vessels came in last night from the southeast part of Cashe's with 460 barrels—most of them larger mackerel. Mackerel have got through spawning; among 100 barrels of them landed at the canning factory I saw no spawn. The weather has been unfavorable for fishing during the last four days—mostly thick fog; with fair weather there would have been a good catch. Mackerel sold to-day for $6.25 a barrel—with the barrel out of pickle, and no inspection.

Pogies are abundant along shore. The small boats catch enough in their nets for bait, which is what they have not done before for five years. The weirs at Portsmouth were full of pogies last Monday; and they have been caught as far east as Portland.

GLOUCESTER, MASS., *June* 21, 1883.

The amount of fish landed at Gloucester during the month of June was as follows: George's Bank cod, 1,579,000 pounds; George's halibut, 44,550 pounds; Western Bank cod, 3,525,000 pounds; Western Bank halibut, 95,000 pounds; Cape North cod, 2,200,000 pounds; shore fish, consisting equally of cod, cusk, and hake, 1,355,000 pounds; fresh halibut caught on Grand Banks, 924,000 pounds; mackerel landed, 12,755 pounds. Two hundred and ninety-five barrels of pogies were caught in seines at the mouth of Gloucester Harbor, and 88 barrels of them were taken in weirs in the harbor; 78 barrels of mackerel were caught in

weirs in the harbor, and 220 barrels of herring were caught among the mackerel in seines.

GLOUCESTER, MASS., *July* 1, 1883.

I will give a few notes on mackerel: On June 24 large mackerel were plentiful on Cashe's Bank. They lasted for two days there, then they disappeared and have not been seen there since. The vessels which were on Cashe's did well, some of them catching as much as 200 barrels in the two days. Small mackerel came along the coast, from Cape Cod to the Bay of Fundy, about June 30. They are numerous but very small, averaging about 6 inches long. On July 2 a school of large ones appeared in Boston Bay. The traps at Kettle Island and Gloucester caught 200 barrels of them, but after one night they disappeared. Ten vessels have gone to the Bay of Saint Lawrence after mackerel, though no mackerel of any account have been caught there yet. One vessel was there a fortnight and caught none. I think mackerel will be caught soon on our coast. The harbor here was full of small mackerel which were schooling.

GLOUCESTER, MASS., *July* 8, 1883.

On July 5 and 6 a school of small mackerel was in the harbor. The weirs, eight in number, caught 500 barrels, 1,200 fish to a barrel. On the 13th and 14th a school of still smaller mackerel came into the harbor. It takes 2,000 of these fish for a barrel. The weirs in the harbor to-day have an average catch of 50 barrels. There are 4 barrels of large mackerel to 50 barrels of the remainder.

James Tarr & Bros. bought all the mackerel in the weirs at $1 a barrel. They intend to salt them round, as they do herring, for an experiment, and try to find a market for them.

Large mackerel are scarce, and the vessels are doing poorly. Fifteen sail have gone to the Bay of Saint Lawrence after mackerel, but the news from the bay is not favorable. Small mackerel are plentiful from Cape Cod to the Bay of Fundy, inshore as well as offshore. It seems too bad to kill them. The vessels set their seines around a school of mackerel and catch perhaps 100 barrels. They then pick out 10 barrels of them and throw the rest overboard. Some vessels which had been gone four weeks returned with but 40 barrels.

The mackerel fleet is spread along the eastern shore from Cape Cod to Cape Sable, and they report nothing but small mackerel. At Kettle Island, Manchester, and Gloucester, within a distance of 10 miles, there are 17 weirs set. This morning they averaged 50 barrels of small mackerel apiece, and some of the weirs were very full.

GLOUCESTER, MASS., *July* 15, 1883.

The vessels which went to George's Bank for cod have done well. A large school of cod has been on the western part of this bank. The fishermen call this the "squid" school, because the fish are full of squid

when caught. Vessels have been supplied with squid from the weirs at Sandwich and Barnstable Bay. The squid caught this year are of the same kind as those caught at Newfoundland, having no bones in them. They are the first of that kind caught on this coast for 10 years. Vessels catch some with a squid-gig on the Bank. Some of the vessels took as much as 50,000 pounds of large cod in six days, using squid for bait.

GLOUCESTER, MASS., *July* 15, 1883.

Large mackerel are scarce, but small ones are plentiful all along the coast. Some vessels arrive with only 30 or 40 barrels after being absent for three weeks. A large fleet has gone to the Bay of Saint Lawrence after mackerel, and two vessels went there to fish for mackerel with hooks. Two vessels have left mackerel-catching and gone after cod, while two other mackerel vessels belonging to Boston have hauled up. The schooner J. J. Clark arrived home with 230 barrels of mackerel caught 120 miles to the eastward (east by south) of Thatcher's Island. They were all caught in 10 days, after which the school disappeared. Large mackerel have been caught on the coast, and it is hard to tell where they have gone. Some think they are at the bottom. The schooner Maud F. Leighton, fishing for cod on the northwest part of George's Bank, caught a large No. 1 mackerel on a cod-hook in 45 fathoms. The captain states that some of the large cod had two or three large mackerel in them when caught. My opinion is that as we have had heavy rains for the last three weeks, this has sunk the seed which the mackerel eat into deep water, and so they leave the surface to feed on it. Four years ago things looked as badly for the mackerel fishermen as they do now, but the vessels did well after August 1. Mackerel bring a high price. They sold yesterday for $16 a barrel for a small lot of mackerel, large rimmed.

GLOUCESTER, MASS., *July* 22, 1883.

Yesterday there were eight vessels in from Grand Banks, with 822,000 pounds salt cod; ten vessels from George's, averaging 35,000 pounds; four from Western Bank, with 110,000 salt cod; four from the shore grounds, with 80,000 pounds of mixed salt fish; and one from Grand Banks, with 20,000 pounds halibut.

A large school of big cod is on the western part of George's Bank, in from 35 to 75 fathoms. It is the first time for twelve years that cod have been caught on George's Bank in 40 fathoms. Generally they have been caught in deep water during June, July, and August. Strange to say, there are no dogfish on the western part of the Bank. The George's fishermen make the trip in twelve or fourteen days; one vessel came in this morning with 40,000 pounds of salt cod, after having been gone but eleven days. The Grand Banks vessels are usually gone about seven weeks for a trip.

A few large mackerel are being caught in the weirs in the harbor here.

Vol. III, No. 12. Washington, D. C. Aug. 31, 1883.

I inclose a couple of newspaper slips relating to the fisheries:

"Wednesday morning, July 18, the menhaden steamer Annie L. Wilcox, of the Wilcox Company, Mystic, made an immense haul of edible fish. The seine was set off Amagansett, about 15 miles to westward of Montauk light, and the haul resulted in the capture of about 30 tons of weakfish, that would average three pounds apiece. It took about an hour and a half to get the fish on board the steamer, and the haul was without any difficulty. It was the largest cargo of fish ever taken to New London."

"The report of W. Z. King, surveyor of customs at Greenport, L. I., shows that for the quarter ending June 30, 44,000,000 menhaden were rendered at the fish factories, 1,375 barrels of oil made, 4,400 tons of fish-scrap made, and 230 tons of edible fish marketed. The number of menhaden rendered does not include several millions taken in pounds and shore seines and not taken to the factories. The yield of oil is the smallest ever known for the quantity of fish rendered, averaging but 1.12 gallons per 1,000."

GLOUCESTER, MASS., *July* 24, 1883.

During the month of July 123 vessels arrived in Gloucester with salt mackerel, amounting to 14,566 barrels, 1,853 barrels of small mackerel, and 124 barrels of large mackerel were caught in traps. The mackerel catchers also landed 300 barrels of small mackerel. One hundred and forty barrels of large herring, caught with seines on the Seal Island grounds, were landed at Gloucester. One hundred and thirteen vessels from George's brought 2,118,000 pounds of cod and 35,710 pounds of halibut. Twenty-six vessels from the Western Banks brought 1,321,000 pounds of cod, 13,850 pounds of salt halibut, and 1,000 pounds of fresh halibut. Twenty-five vessels from the Grand Banks landed 2,762,000 pounds of salt cod and 37,000 pounds of salt halibut; 21 vessels from Grand Banks landed 487,000 pounds of fresh halibut; 32 shore fishing vessels landed 180,000 pounds of salt cod, 99,000 pounds of salt cusk, 50,000 pounds of salt hake, and 800 pounds of salt pollock. Five hundred quintals of dried fish (mixed) were brought from Maine by freight. The papers report that very large catches of menhaden were made by the Long Island fish steamers last week. "The fish were along the coast covering hundreds of acres. The factories at the east end of the island were choked with fish and have been running day and night. The bay fishermen have also done better than any previous time this season. At the Newport factory 2,000,000 fish were received and rendered in three days. The menhaden were never before known to be so plentiful."

GLOUCESTER, MASS., *August* 2, 1883.

Mackerel come in very slowly. What are received have been caught 180 miles east by south from Thatcher's Island. Most of them are mixed with small ones. The schooner Charles E. Warren arrived yesterday with 100 barrels of large mackerel. The captain told me that he caught 800 barrels from which he selected these, throwing overboard the other 700 barrels. The rest of the fleet is doing much the same way. Three hundred sail of mackerel catchers will destroy a great many fish. Last year, to the 4th of August, 96,000 barrels of mackerel had been landed; this year, only 20,000 barrels. The small mackerel are very plenty on George's Bank. There are a few large mackerel in our harbor which are caught close to the bottom, are very fat and very large. It takes only one hundred of them to fill a barrel. Mackerel sold yesterday at $14 a barrel, including the barrel; last year at this time they brought $7 a barrel, including the barrel.

The cod fishermen on George's Bank are doing well whenever they can get squid for bait. The captain of the schooner Lettie Hawes says he never saw squid so abundant as this year. They were in large schools all of last week. The captain says that pollock have never before staid so late as this year. The squid keep them here.

Porgies are plenty in the weirs at Hyannis, Chatham, and Portsmouth. A salmon was caught in a trap in the harbor which weighed 9½ pounds. One bluefish was caught in a mackerel-net last week in the harbor.

GLOUCESTER, MASS., *August* 5, 1883.

During the past week mackerel fishing has been better This morning I found that 15 mackerel vessels had arrived in the harbor, three of them from the Bay of Saint Lawrence with 320 barrels of fish each The other 12 had been fishing on the coast and had obtained 200 barrels each. The prospect for mackerel in the Bay of Saint Lawrence is good. Those caught along the shore are mostly from the eastern part of Cashe's Bank, where they seem to be plenty though they do not come to the surface. Those caught were seen from two to five fathoms below the surface of the water. Captain King told me to-day that he has never seen so many birds before in the Bay of Fundy, such as sea-geese, gannet, and hagdowns. Sharks and swordfish are also plenty.

One schooner from the Grand Banks arrived yesterday with 290,000 pounds of salt cod having been absent three months. The schooner Amelia S. Cole arrived yesterday with 280,000 pounds of salt cod taken with hand lines on Banquereau, having been absent 11 weeks. The schooner Otis P. Lord brought in 50,000 pounds of cod from George's Bank, having been absent fifteen days. Little, if anything, has been caught in traps during the past week. Mr. Bates caught a sturgeon in his trap last Thursday which weighed 165 pounds. Of course mackerel have been very plenty and one was shot in the Squam River.

GLOUCESTER, MASS., *August* 12, 1883.

14.—AN ACCOUNT OF THE WHALE FISHERY OF NANTUCKET, MASS., ONE HUNDRED YEARS AGO.*

By J. HECTOR ST. JOHN.

The vessels most proper for whale fishing are brigs of about 150 tons burthen, particularly when they are intended for distant latitudes; they always man them with thirteen hands, in order that they may row two whale-boats, the crews of which must necessarily consist of six—four at the oars, one standing on the bows with the harpoon, and the other at the helm.

It is also necessary that there should be two of these boats, that if one should be destroyed in attacking the whale the other, which is never engaged at the same time, may be ready to save the hands. Five of the thirteen are always Indians; the last of the complement remains on board to steer the vessel during the action. They have no wages; each draws a certain established share in partnership with the proprietor of the vessel, by which economy they are all proportionally concerned in the success of the enterprise, and all equally alert and vigilant. None of these whalemen ever exceed the age of forty; they look on those who are past that period not to be possessed of all that vigor and agility which so adventurous a business requires. Indeed, if you attentively consider the immense disproportion between the object assailed and the assailants; if you think on the diminutive size and weakness of their frail vehicle; if you recollect the treachery of the element on which this scene is transacted, the sudden and unforeseen accidents of winds, &c., you will readily acknowledge that it must require the most consummate exertion of all the strength, agility, and judgment of which the bodies and the minds of men are capable, to undertake these adventurous encounters.

As soon as they arrive in those latitudes where they expect to meet with whales, a man is sent up to the mast-head; if he sees one he immediately cries out, "*Awaite Pawana*" ("Here is a whale"). They all remain still and silent until he repeats *Pawana* (a whale), when in less than six minutes the two boats are launched, filled with every implement necessary for the attack. They row toward the whale with astonishing velocity; and as the Indians early became their fellow-laborers in this new warfare, you can easily conceive how the Nattick expressions became familiar on board the whale-boats. Formerly it often happened that whale vessels were manned with none but Indians and the master; recollect, also, that the Nantucket people understand the Nattick, and that there are always five of these people on board.

There are various ways of approaching the whale, according to their

*From "Letters of an American Farmer," &c. London. 8°. 1782. pp. 162-171.

peculiar species; and this previous knowledge is of the utmost consequence. When these boats are arrived at a reasonable distance, one of them rests on its oars and stands off as a witness of the approaching engagement; near the bows of the other the harpooner stands up, and on him principally depends the success of the enterprise. He wears a jacket closely buttoned, and round his head a handkerchief tightly bound; in his hands he holds the dreadful weapon, made of the best steel, marked sometimes with the name of their town, and sometimes with that of their vessel, to the shaft of which the end of a cord of due strength, coiled up with the utmost care in the middle of the boat, is firmly tied; the other end is fastened to the bottom of the boat. Thus prepared they row in profound silence, leaving the whole conduct of the enterprise to the harpooner and to the steersman, attentively following their directions. When the former judges himself to be near enough to the whale, that is, at the distance of about fifteen feet, he bids them stop; perhaps she has a calf, whose safety attracts all the attention of the dam, which is a favorable circumstance; perhaps she is of a dangerous species, and it is safest to retire, though their ardour will seldom permit them; perhaps she is asleep—in that case he balances high the harpoon, trying in this important moment to collect all the energy of which he is capable. He launches it forth—she is struck; from her first movement they judge of her temper, as well as of their future success. Sometimes in the immediate impulse of rage she will attack the boat and demolish it with one stroke of her tail; in an instant the frail vehicle disappears and the assailants are immersed in the dreadful element. Were the whale armed with the jaws of the shark, and as voracious, they never would return home to amuse their listening wives with the interesting tale of the adventure. At other times she will dive and disappear from human sight, and everything must then give way to her velocity, or else all is lost. Sometimes she will swim away as if untouched, and draw the cord with such swiftness that it will set the edge of the boat on fire by the friction. If she rises before she has run out the whole length, she is looked upon as a sure prey. The blood she has lost in her flight weakens her so much, that if she sinks again it is but for a short time; the boat follows her course with an almost equal speed. She soon reappears; tired at last with convulsing the element, which she tinges with her blood, she dies, and floats on the surface. At other times it may happen that she is not dangerously wounded, though she carries the harpoon fast in her body, when she will alternately dive and rise, and swim on with unabated vigor. She then soon reaches beyond the length of the cord and carries the boat along with amazing velocity; this sudden impediment sometimes will retard her speed, at other times it only serves to rouse her anger and to accelerate her progress. The harpooner, with the ax in his hands, stands ready. When he observes that the bows of the boat are greatly pulled down by the diving whale, and that it begins to sink deep and to take much water, he brings the

ax almost in contact with the cord; he pauses, still flattering himself that she will relax, but the moment grows critical, unavoidable danger approaches. Sometimes men more intent on gain than on the preservation of their lives will run great risks, and it is wonderful how far these people have carried their daring courage at this awful moment! But it is vain to hope; their lives must be saved, the cord is cut, the boat rises again. If after thus getting loose she reappears, they will attack and wound her a second time. She soon dies, and when dead she is towed alongside of their vessel, where she is fastened.

The next operation is to cut with axes and spades every part of her body which yields oil; the kettles are set a boiling; they fill their barrels as fast as it is made; but this operation is much slower than that of cutting up; they fill the hold of their ship with those fragments, lest a storm should arise and oblige them to abandon their prize.

It is astonishing what a quantity of oil some of these fish will yield, and what profit it affords to those who are fortunate enough to overtake them. The river Saint Lawrence whale, which is the only one I am well acquainted with, is 75 feet long, 16 deep, 12 in the length of its bone—which commonly weighs 3,000 pounds—20 in the breadth of the tails, and produces 180 barrels of oil. I once saw 16 barrels boiled out of the tongue only.

After having once vanquished this leviathan, there are two enemies to be dreaded besides the wind, the first of which is the shark. That fierce, voracious fish, to which nature has given such dreadful offensive weapons, often comes alongside, and in spite of the people's endeavors will share with them in their prey, at night particularly. They are very mischievous, but the second enemy is much more terrible and irresistible; it is the killer, sometimes called the thrasher, a species of whales about 30 feet long. They are possessed of such a degree of agility and fierceness as often to attack the largest spermaceti whales, and not seldom to rob the fishermen of their prey; nor is there any means of defense against so potent an adversary.

When all their barrels are full, for everything is done at sea, or when their limited time is expired and their stores almost expended, they return home freighted with their valuable cargo, unless they have put it on board a vessel for the European market. Such are, as briefly as I can relate them, the different branches of the œconomy practiced by these bold navigators, and the method with which they go such a distance from their island to catch this huge game.

The following are the names and principal characteristics of the various species of whales known to these people:

The river Saint Lawrence whale, just described; the disko, or Greenland, ditto; the right whale, or seven-feet bone, common on the coasts of this country, about 60 feet long; the spermaceti whale, found all over the world, and of all sizes—the largest are 60 feet and yield about 100 barrels of oil; the hump-backs, on the coast of Newfoundland, from 40

to 70 feet in length; the fin-back, an American whale—never killed, as being too swift; the sulphur-bottom, river Saint Lawrence, 90 feet long—they are but seldom killed, as being extremely swift; the grampus, 30 feet long—never killed, on the same account; the killer or thrasher, about 30 feet—they often kill the other whales, with which they are at perpetual war; the black-fish whale, 20 feet—yields from 8 to 10 barrels; the porpoise, weighing about 160 pounds.

In 1769 they fitted out 125 whalemen; the first 50 that returned brought with them 11,000 barrels of oil. In 1770 they fitted out 135 vessels for the fisheries, at thirteen hands each; 4 West Indiamen, twelve hands; 25 wood vessels, four hands; 18 coasters, five hands; 15 London traders, eleven hands. All these amount to 2,158 hands, employed in 197 vessels. Trace their progressive steps between the possession of a few whale-boats and that of such a fleet.

The moral conduct, prejudices, and customs of a people who live two-thirds of their time at sea must naturally be very different from those of their neighbors, who live by cultivating the earth. That long abstemiousness to which the former are exposed, the breathing of saline air, the frequent repetitions of danger, the boldness acquired in surmounting them, the very impulse of the winds, to which they are exposed; all these, one would imagine, must lead them, when ashore, to no small desire of inebriation, and a more eager pursuit of those pleasures of which they have been so long deprived, and which they must soon forego. There are many appetites that may be gratified on shore, even by the poorest man, but which must remain unsatisfied at sea. Yet, notwithstanding the powerful effects of all these causes, I observed here, at the return of their fleets, no material irregularities; no tumultuous drinking assemblies; whereas in our continental towns the thoughtless seaman indulges himself in the coarsest pleasures; and, vainly thinking that a week of debauchery can compensate for months of abstinence, foolishly lavishes in a few days of intoxication the fruits of half a year's labor. On the contrary, all was peace here, and a general decency prevailed throughout; the reason, I believe, is that most everybody here is married, for they get wives very young; and the pleasure of returning to their families absorbs every other desire. The motives that lead them to the sea are very different from those of most other sea-faring men; it is neither idleness nor profligacy that sends them to that element; it is a settled plan of life, a well-founded hope of earning a livelihood; it is because their soil is bad that they are early initiated to this profession, and were they to stay at home, what could they do? The sea, therefore, becomes to them a kind of patrimony; they go to whaling with as much pleasure and tranquil indifference, with as strong an expectation of success, as a landman undertakes to clear a piece of swamp.

15.—HISTORY OF THE EXPERIMENTS LEADING TO THE DEVELOPMENT OF THE AUTOMATIC FISH-HATCHING JAR.

By MARSHALL McDONALD.

The work of practical pisciculture was, until a comparatively recent period, confined for the most part to the hatching of the different species of the salmonidæ. The incubation of the eggs was at first effected in troughs having the bottoms covered with a layer of gravel, upon which the eggs were placed and over which a current of fresh water was allowed to flow.

In succession followed the "grill system" of M. Coste and the different devices of movable trays now in common use for handling this class of eggs. In all these various methods the separation of the dead eggs from the live ones was effected by means of hand-picking. The necessity for the separation, although not so urgent in the case of the eggs of the salmonidæ as in that of those eggs which develop in warmer waters and in much shorter periods of time, still entails a vast amount of labor in connection with the hatching operations.

Although the ingenuity of our fish-culturists has greatly improved the forms of hatching apparatus for these heavy eggs, yet up to a comparatively recent period no other effectual means of separation than that above indicated has been found practicable. The United States Fish Commission, in the development of its work, had presented to it the necessity of dealing with the eggs of the whitefish and the shad upon a scale unprecedented in the history of fish-culture. Millions of eggs were to be hatched where fish-culturists formerly handled only thousands, and the old methods of hand-picking were soon found to be impracticable.

In all of the forms of apparatus for bulk hatching no adequate means is employed for the separation of the dead eggs from the living. All, as they come from the fish, the unimpregnated as well as impregnated, are placed in the apparatus and remain together.

In the case of the whitefish, and more especially in the case of the shad eggs (which run through their period of incubation in a much shorter time), fungus rapidly develops among the dead eggs, communicates itself to the living, and large numbers of them, which would otherwise reach the period of hatching, are destroyed. The percentage of loss produced in this way is always considerable, and in many cases none of the eggs undergoing incubation are saved. The attention of fish-culturists was early directed to the serious losses thus arising, and various experiments have been made with a view of effecting the separation of the dead from the living eggs.

In 1878 Mr. F. N. Clark, the superintendent of the United States Hatchery at Northville, Mich., attempted to effect the separation by

introducing a gate into one side of the cone, through which the shells and fish and dead eggs might go out into appropriate receptacles. This device, so far as it served for the collection of the young fish, was quite successful; but it was not found capable of doing the work for which it was first planned by Mr. Clark, and was abandoned. Similar experiments, looking to the same result, were made by him with the Chase jar—the form of apparatus employed for the whitefish work at the Northville station. The result of these experiments, however, led Mr. Clark to the conclusion that an automatic or self-picking arrangement for effecting the complete separation of the dead from the live eggs was not practicable, and a paper to that effect was written and published by him in Vol. I, Bulletin of the United States Fish Commission (1881, p. 62). The present method employed by him for the separation of the dead whitefish eggs is to siphon off the dead eggs and such live eggs as are necessarily drawn over with them, and to transfer them to what he terms "hospital jars," the live eggs thus drawn over being left to take their chances with the dead ones.

This mode of treatment undoubtedly has served to diminish materially the percentage of loss in the eggs, thus treates by him, as in this way, by the sacrifice of a small proportion of the eggs, he secured the complete separation of all elements of contamination and disease from the great bulk of the eggs.

In 1881, while I was in charge of a shad-hatching station on the Potomac River, and in position to observe closely the performance of the hatching apparatus in use, the question of the separation of the dead from the living eggs was taken up systematically, with the view of devising a form of apparatus which would accomplish the purpose and which would be of such shape as to be of easy and convenient use in practice. Knowing that there was an apparent difference in the specific gravity of the living and the dead eggs I determined to see if I could not avail myself of this difference to effect the separation. The first form of apparatus employed is represented in Fig. 1.*

* This consists essentially of an oblong trough with wooden ends and sloping glass sides, glass being used in order to be able to observe the movement of the eggs under the influence of the currents. This trough rests upon a rectangular box made of boards, which serves at once as a firm base for the support of the trough, and as a chamber for the equable distribution of the water pressure. The water, which enters the rectangular box forming the base of the apparatus through the supply pipe I, passes to the trough proper through a slot extending the whole length. The influx of the water to the trough is regulated by the valve V V′, which, by means of the set rods S S, can be pushed down so as to cut off the flow of water entirely. By setting so as to have the opening between the valves and the glass sides about one thirty-second of an inch, the water enters the hatching trough in thin sheets which are directed up the glass sides of the trough. The effect of this is to give the eggs a continuous movement in the direction shown by the arrows. The water flows over the edges of the central trough, and escapes from the apparatus at O. The dead eggs in their circuit float higher than the living, and the force of the entering current may be so regulated that the former will be swept out by the escaping water.

In the use of this apparatus I found that a fair separation could be effected, but to accomplish this required perfect stability of the vessel

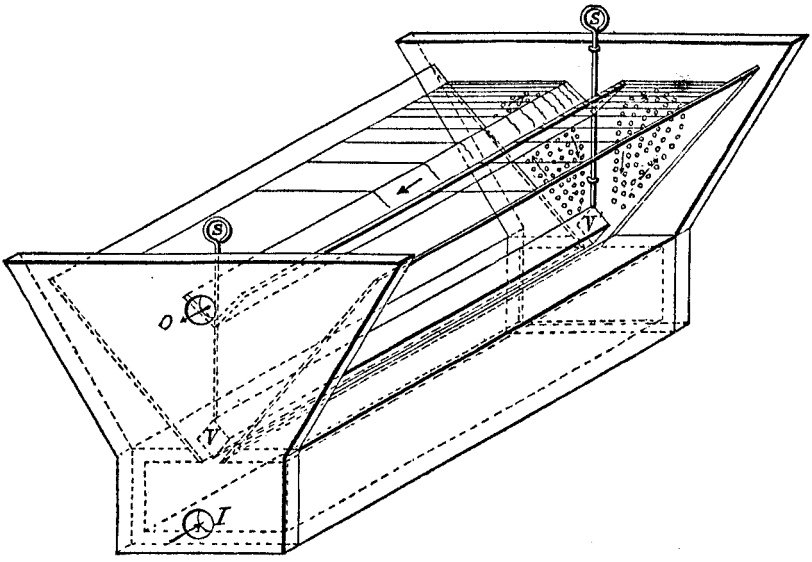


FIG. 1.—Original form of apparatus employed in the experiments. Used May, 1881, on the Potomac barges.

and careful manipulation. When the barges were lying quietly on the water, and there was no tide swell in the river, the separation went on perfectly, the dead eggs being continually thrown off from the mass of living eggs and swept by the current over into the exit trough and car-

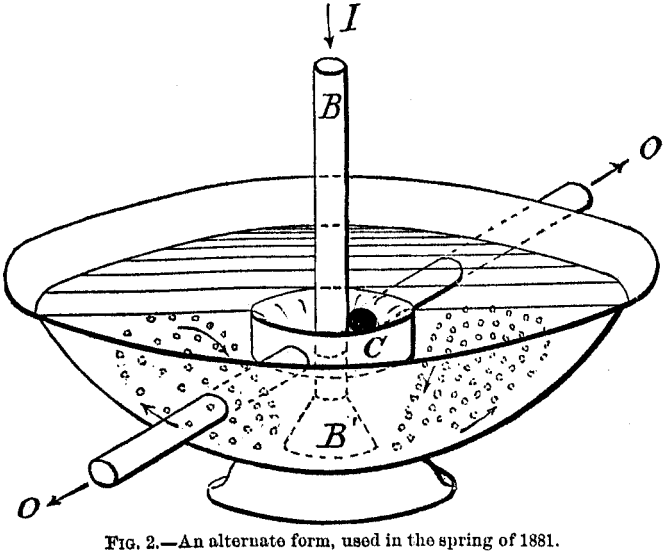


FIG. 2.—An alternate form, used in the spring of 1881.

ried off from the apparatus. The slightest oscillation, however, of the barge, produced by waves, would derange the orderly movements of the

eggs, and required continual watchfulness on the part of the attendant to prevent considerable losses of live eggs. A second form of apparatus, looking to the accomplishment of the same result, is shown in Fig. 2.

The results with these forms of apparatus were not satisfactory in developing a method which could be conveniently applied in practice, yet they pointed the way to it. Later in the spring, near the close of the hatching season, at the suggestion of Professor Baird, and in conjunction with Professor Ryder, we instituted, in the basement of the Smithsonian Institution, a series of experiments in order to determine the limit of healthy retardation of development that could be effected by lowering the temperature of the water employed. In order to subject the eggs conveniently to the action of the current of cold water

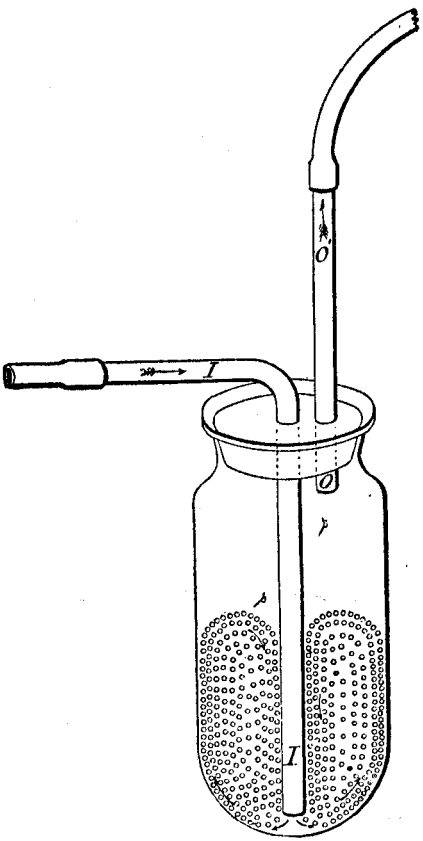


FIG. 3.—Original form of apparatus in which the method for automatic separation of dead from living eggs was demonstrated.

they were placed in small two-ounce laboratory flasks, closely corked. Through the center of the cork was passed a glass tube which descended to within a short distance of the bottom of the flask, and through which the current of water was admitted to the apparatus. This is shown in Fig. 3.

An exit tube, the lower extremity of which extends a short distance below the neck of the bottle, provided for the escape of the water. Whilst this form of apparatus had been devised by me in connection with the experiments on retardation above referred to, I had no sooner fixed upon the apparatus than I felt at once I had arrived at the solution of the question of automatic separation of the dead from the living eggs. An eight-ounce wide-mouthed glass jar, such as is used in the National Museum for holding alcoholic specimens, was fitted up as indicated (Fig. 3).

Six thousand shad eggs were placed in this apparatus and a current of water turned on and regulated. The movement of the current established a regular rolling, boiling motion on the eggs, which brought all in succession to the surface. The dead eggs remained there, forming as they were freed from the mass a layer upon the upper surface of the others. By pushing down the exit tube a suitable distance, I found that the dead eggs were taken up by the escaping current, were by degrees drifted under the lower end of the tube, lifted through it by the current, and swept out, leaving an absolutely clean mass of live eggs in the jar.

This lot of eggs was successfully hatched, and at the time of hatching not a dead egg was found in the bottle, nor do I think a live egg was lost in the whole course of the experiment.

The first experiments had been framed solely with reference to the assumed slight difference in the specific gravity of the living and the dead eggs. Attentive study of the movement of the eggs in the jar showed a still more potent influence for separation than the difference in the specific gravity. It is true there is a slight difference in this respect, but it is hardly appreciable. The more important difference, and that upon which the success of the apparatus depends, is the close adhesion which exists between the living eggs, the effect being that the live eggs rolling in mass are always in contact, even when they reach the surface, and are by this adhesion carried around in regular sequence. On the other hand, the dead eggs having once reached the surface, their adhesion to the underlying layer of eggs is not sufficient to draw them along with it in its regular movement; consequently when they once reach the surface of the mass they remain there until they are carried off by the exit tube. Several experiments made with different lots of eggs gave uniformly the same satisfactory results.

In May, 1881, the apparatus in actual operation was exhibited before a meeting of the Biological Society held in the basement of the Smithsonian Institution. These experiments were so decisive that I did not hesitate to recommend and urge the adoption of the new method in the work of the United States Fish Commission.

In the spring of 1882 it was determined to convert the old Armory building into what is now known as the Central Hatchery and Distributing Station. Prof. S. F. Baird was pleased to manifest his confi-

dence in the success of the new form of hatching apparatus by authorizing me to equip the station with them. The working form of apparatus not having been then even designed on paper, it was not possible

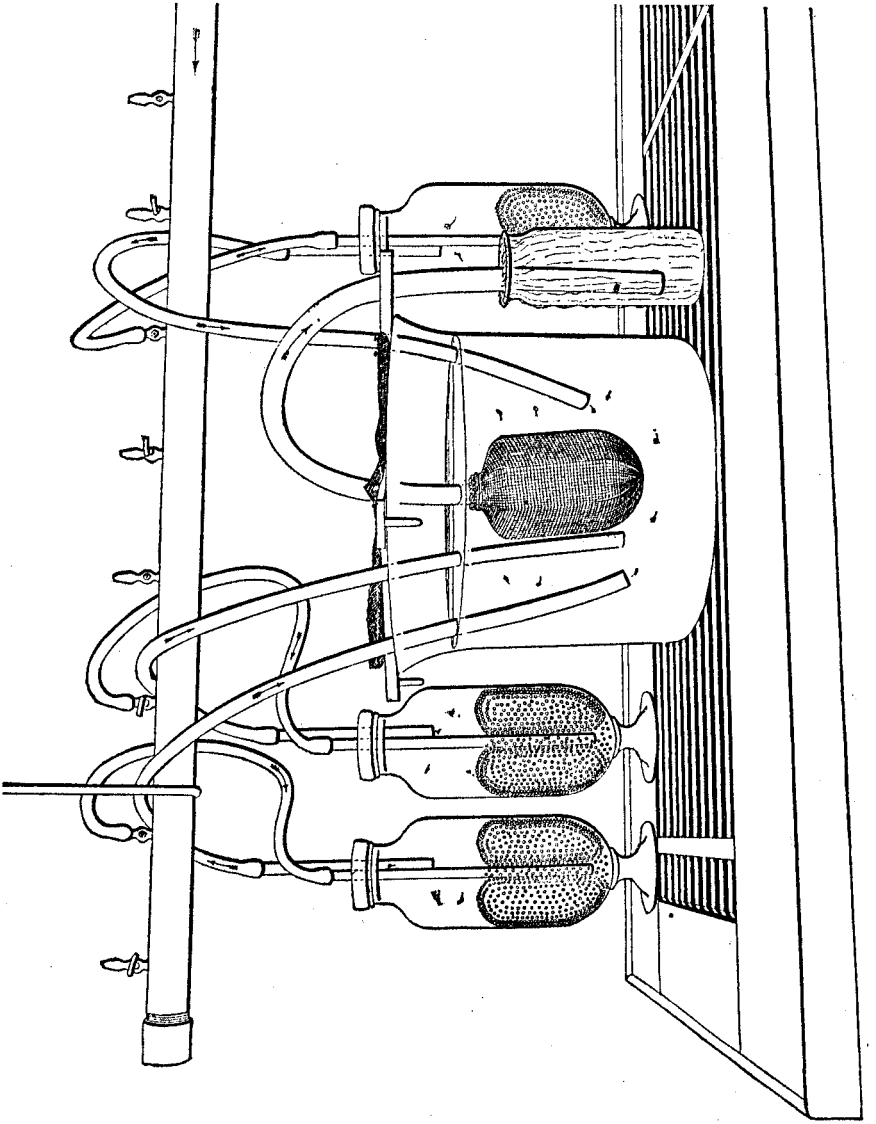


FIG. 4.—Details to illustrate hatching and transfer of shad fry to collectors.

to prepare the drawings and to have the jar complete in all details ready in time for the shad-hatching season. An improved form was devised in which cork stoppers were substituted for the screw cap and metal tops employed in the form now fixed upon. Ten tables suitably planned to receive the waste water from the jars and carry it off from the building were constructed, the pipes for the distribution of water supply to

the tables were introduced, and the station was equipped with 300 of the jars. Each jar having a capacity of 60,000 to 70,000 shad eggs gave a total hatching capacity to the station of 21,000,000 eggs at one time, or 900,000,000 for the entire shad-hatching season. This was, of course, in excess of any expected production; but in the organization of a shad station it is necessary to provide for the contingency of the great bulk of the eggs coming within an interval of a few days of each other. The form of hatching apparatus used during this season is shown in Fig. 4.

The general arrangement of a hatching table for the collection of the young fish as they hatch in appropriate receivers or aquaria is also shown in Fig. 4. The present form of apparatus and the form contemplated in the first design, but only completed recently, is indicated in Fig. 5.

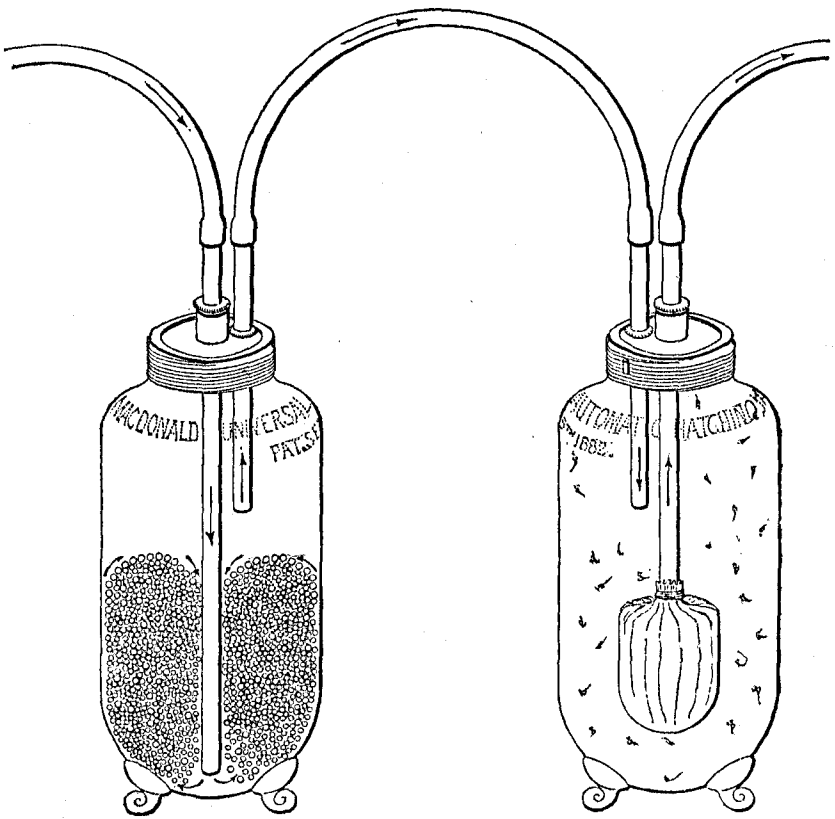


FIG. 5.—Arrangement of jars for hatching and collecting, as in use at present.

In this figure we have shown a pair of jars fitted up, one for the hatching of the eggs, the other for the collection of the young fish.

The jar consists essentially of a cylindrical glass vessel with hemispherical bottom. These are not blown, but pressed, in order to secure perfect regularity of the interior surface, upon which depends to some

extent the perfect working of the jar. The glass foot which is shown in the improvised form has been omitted in the form now in use, the jar being supported upon a tripod of three glass lugs; this form of attachment being adopted to prevent the distortion of the bottom of the jar, which would necessarily result from the attachment of a single foot to it.

The top of the jar is made with threads to receive a screw cap, and both the bottom and the top surfaces are ground so that the plane of each shall be perpendicular to the axis of the jar and so that when the jar is resting upon its feet its axis shall be perfectly vertical.

These are all-important considerations to secure the proper working. The top of the jar is closed by a metallic disk perforated with two ⅝-inch holes—one perfectly central, which admits the tube that introduces the water into the jar; the other equally distant from the central hole and from the edge of the plate. A groove in the inner surface of this metallic plate carries a rubber collar, and when the plate is in place the tightening of the metallic screw cap shown in the figure seals the opening hermetically. Both the inlet and outlet tubes pass through stuffing boxes, by which means the tubes can be slid up and down easily and tightened firmly in any desired position. The construction of the jar is such that when the metallic disk is in place the central tube takes the central position necessarily; by loosening the screw cap of the stuffing box the central tube can be slid up or down so as to produce just such movement of the eggs as is desired. If the quantity of water entering be small, or the head of water slight, without changing the feed of water we may vary at will the force and velocity with which it enters the jar. By pushing the tube down so as to be almost in contact with the bottom of the jar we make a relatively small quantity of water do the work of a larger quantity in producing motion. Moreover, as in the season of shad hatching, a full supply of water is needed and not a great deal of motion, this is arranged for by increasing the feed and raising the lower end of the central or supply tube, so that the delivery of the water from it will be under less pressure. This central tube is connected by a rubber pipe with the pet cock which furnishes a supply of water under a constant head.

The exit tube serves a double purpose—first, as an outlet for the water; and secondly, at our pleasure to remove the layer of dead eggs from the surface. This is accomplished at stated intervals, say once in twenty-four hours, by loosening the screw of the stuffing box so that the tube will slide readily, pushing it down until the dead eggs nearest to the lower end are seen to begin to pass off. By allowing it to remain in this position a few minutes the layer of dead eggs is swept off entirely. They may be either allowed to pass off in the waste, or better, collected by screens and fed to the fish in the aquaria, thus serving the double purpose of preventing the fouling of the water and furnishing a very appropriate food for many varieties of fish. When the period of hatch-

ing approaches, instead of allowing the water from the hatching jars to pass directly into the sinks, it is necessary to conduct it through the collecting jar. This is precisely similar in construction to the hatching jar. Indeed it is the hatching jar with some special arrangements to adapt it to its new purpose. The water passes from the hatching jar through the rubber tube into the eccentric opening of the receiving jar. The tube and opening then serve for the inlet instead of the outlet of the water. On the lower end of the central tube is placed a wire frame, over which is drawn a bag made of cheap cotton, the texture of which is such as to permit the water to strain through, but the meshes of which are so fine that the suction of the water will not hold the young fry against it as would be the case if a wire screen were used.

The surface of this strainer should be as large as is convenient. It is adjusted to the lower end of the central tube in such position that the end of the tube is in the center of the wire cage, or as nearly so as possible, the object of this being to make the draw of the water equal in all directions. The water is allowed to pass out of this second receiving jar out into the waste. The young fish, if they be whitefish or shad, as soon as they burst their shells begin to swim around vigorously in the hatching jar, drifting with the current. They pass into the exit tube and are carried over into the receiver, in which they may be collected to any number desired, being retained there without injury until it is convenient to make a shipment.

In extensive work in hatching I have found it more convenient to make use of large glass aquaria for receivers, four or five hatching jars being disposed around one, which serves as a common collector for the young fish from all. A siphon, arranged as shown in Fig. 4, with a wire cage and strainer on the shorter end, serves to give free discharge to the water while the strainer prevents any fish from passing out. I have found the hatching jars to be a very compact form of apparatus for handling the eggs of the salmonidæ. In this case it is not desired to nor do we give any motion to the eggs. The jar is filled with them from one-half to two-thirds full. The current of water being introduced at the bottom filters up through them, enveloping each egg in a stratum of fresh water, and placing each under the best possible conditions of development. From fifteen to eighteen thousand eggs may be readily placed in each jar. Of course, in the case of these eggs we must have recourse to hand-picking. This is readily accomplished by opening the jars, placing the hand over the mouth to prevent the escape of water, inverting and placing the mouth under water over a broad shallow tray. The eggs by gravity flow out and spread over the bottom of this, and when picked over are returned to the jar, the precaution being observed to have the jar full of water, and to use a broad flat funnel to return the eggs. They may be poured from the tray into the jar in bulk without any injury.

From the experience had during the winter of 1882 in hatching this

class of eggs at Central Station I am convinced that large numbers of eggs up to the very period of hatching can be handled in this jar.

The necessity of arriving at methods of hatching the light or floating eggs of many of our salt-water fishes has for several years impressed itself upon the United States Fish Commission. No form of apparatus heretofore devised has been satisfactorily operated to the accomplishment of this purpose. The experiments made during the summer of 1882 in the Chesapeake Bay with the eggs of the Spanish mackerel led to the hope that the hatching jar, fitted up as a receiver, may be with equal advantage employed in hatching this class of eggs. The number of eggs obtainable was not enough to give results sufficiently decisive to establish this assertion. But these eggs, being subjected under the conditions presented in the receiving jar to a current of salt water, being confined so as to prevent escape, and this confinement effected without the use of appliances that would injure the delicate membrane of the shell, there seems to be no reason why we may not use the jar as successfully with this class of eggs as with those of the whitefish and the shad.

UNITED STATES FISH COMMISSION,
Washington, D. C., April 6, 1883.

16.—THE SUCCESSFUL STOCKING OF STREAMS WITH TROUT.

By WAKEMAN HOLBERTON.

[From a letter to Prof. S. F. Baird.]

Near Cleveland, Ohio, is a stream, very much of the nature of Caledonia Creek, only finer and larger, which gushes from the earth in such volume as to turn a mill not far from its source. This stream never contained trout until 1872, when it was leased by a club and stocked with trout which, I think, were obtained from Lake Superior. Since then the trout have increased finely and the fishing is superb. It is not unusual for trout to be taken there of three or even four pounds weight. The members of the club are restricted to fifteen pounds a day, and only allowed to fish three days in a week. The fish are well fed and very lively.

The trout which were put into some streams near here two years ago are doing well. I noticed a marked increase in fishing last spring. The California trout that we put in in 1881 were doing finely last year, and had already grown to the size of four inches. I caught several of them but returned them to the water.

NEW YORK, *March* 9, 1883.

Vol. III, No. 13. Washington, D. C. Sept. 3, 1883.

17.—ON THE THREAD-BEARING EGGS OF THE SILVERSIDES (MENIDIA).

By JOHN A. RYDER.

Three years have elapsed since the writer was enabled to study the remarkable ova of the genus *Menidia*, on the night of July 3, 1880, in Mobjack Bay, Matthews County, Virginia, near New Point Comfort lighthouse, and he has delayed any further and fuller account of what was then observed, in the hope that additional material might be obtained in order that the embryological history of the genus might also be investigated. This delay has not yet enabled the author to get the desired material, and he therefore proposes to describe only what he has observed respecting the mature unimpregnated ova.

In earlier papers, published in this Bulletin, I have incidentally alluded to the eggs of *Menidia* under the name of *Chirostoma*, as then current, and in order to avoid misapprehension it will therefore be necessary to first consider the form in respect to its systematic place and synonymy. According to Jordan and Gilbert (Synopsis of the Fishes of North America), *Menidia* is the proper designation of a rather common type of Atherinoid fishes, of small size, the species of which have collectively received the name of "silversides," probably from the presence of a broad silvery band on the sides of the translucent greenish body. They resemble markedly the *Mugilidæ* or mullets in general appearance, and are allied to them. The species now included under *Menidia* have been placed in a number of genera by different authorities, such as *Chirostoma*, *Atherinicthys*, *Argyrea*, *Basilichthys*, &c., but the form in question which furnished the eggs for our study corresponded most nearly with that of *Chirostoma notata* of later writers, so that *Menidia notata*, Mitch. (J. & G.) is the now recognized name of the form here considered.

It may also be of interest to give some account of the circumstances under which the eggs were obtained. The steamer Lookout was lying at anchor after dark in about two or three fathoms of water; some of the crew while fishing for crabs noticed that a great many small fishes, four or five inches long, were being attracted by the lights which they held over the side of the vessel. Some of these were soon captured by Mr. William Hamlin and Mr. W. P. Sauerhoff, who upon pressing the specimens found that some of them were gravid females with ripe eggs in their roes. No mature males were obtainable at the time, and inasmuch as I was engaged during the rest of my stay upon the study of the development of two other species of valuable food-fishes, I had no

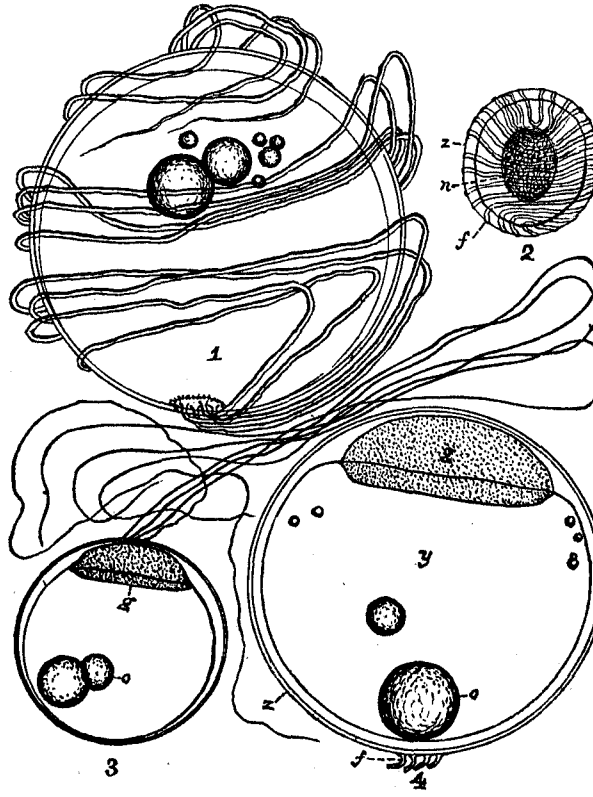
further opportunity to carry my researches any farther. The material which was obtained was however of such an interesting character that I immediately made a number of camera lucida sketches and a few notes, which I now reproduce.

The eggs being taken at night, renders it possible that the species is a nocturnal spawner, while the singular threads or filaments may be the means by which the parent fish is enabled to suspend its ova to some fixed support in the water as they are emitted from the oviduct. This might be accomplished by the female while the eggs were expelled by simply passing her body over the stems or leaves of marine plants in her vicinity. This affords an explanation of the remarkable threads which are attached to and at first encircle the eggs. We cannot escape the conclusion, at any rate, that these threads are of the nature of a protective contrivance either to suspend the eggs to foreign objects or else to entangle them together in masses; such as we find to be the case with the eggs of the silver-gar, where the filaments are, however, scattered over the whole surface of the egg. The eggs of the silver-gar are, moreover, actually found suspended in masses in the meshes of the pound-nets in which the adult females have been entrapped, but whether the fish themselves have been the means of suspending them there is uncertain. Possibly currents of water may waft them into the meshes of the nets, but this is to some extent improbable from the fact that the ova of the gar are much heavier than sea-water and immediately sink to the bottom. The eggs of *Menidia notata* are also heavier than water, and it is therefore very possible, as previously suggested, that this form, too, may, when spawning, avail itself of the threads on its ova to suspend them by, so as to keep them out of the mud and prevent them from being smothered and killed. The filaments of adjacent eggs in the gar have a tendency to twist spontaneously around each other, so that great masses are often formed in this manner and held together entirely by the tough fibers or filaments which are attached to the egg membrane. The same is true of the eggs of *Menidia*, but in this genus the eggs are not deposited in such numbers, because the ovary of a full-grown female would probably not yield more than 300 eggs during a single spawning season, while that of the female silver-gar would yield as many as 800 to 1,000 ova.

The mature eggs of *Menidia notata* measure about a line in diameter, and as shown in Fig. 1, in the accompanying cut, are covered with a thick, strong egg-membrane, *z*. When first taken from the parent fish, the germinal matter of the ovum is spread mainly over the surface of the vitellus, and in the latter a number of highly refringent oil globules of various sizes are embedded, as shown in Figs. 1, 3, and 4. In the space of ten hours the batch of ova studied by the writer had developed the germinal disk *g* independently of impregnation.

Probably the most striking peculiarity about the ova of *Menidia* is the garniture of threads which are attached to one pole of the egg, covering

a very small area of insertion on the outer surface of the egg-membrane. There are four of these filaments *f*, as indicated in Figs. 1, 3, and 4, and when the eggs are first emitted they are coiled around the egg-membrane externally in a spiral manner, as shown in Fig. 1. Very soon



after oviposition they commence to uncoil from around the egg, and when a number are stirred or shaken about in a small dish they soon become entangled together so as to hang together in bunches or strings. These threads are about eight times the length of the diameter of the ovum, and are apparently composed of the same tough material as that which enters into the formation of the egg-membrane itself. In the immature condition, and when the ovarian egg is still far from full-grown, I find the threads present on the outside of the zona or membrane, but closely adherent to the latter, as may be seen in Fig. 2, representing a young and immature ovarian egg. In this condition the membrane is relatively thicker than in more mature eggs, and the nucleus *n* is quite conspicuous at the center of the immature vitellus.

The filaments *f*, Fig. 4, at the point of attachment to the egg-membrane are somewhat enlarged, but have no bulbous base as in the case of those found on the ova of the silver-gar. The egg is heavier than sea-water, the oil-drops *o* embedded in the yelk *y* seeming to have no tendency to buoy them up.

It appears that the number of ova produced by various species of Teleostean fishes are in some way proportioned to the chances they may have of surviving. Viviparous forms like the Cyprinodonts have comparatively few ova, and the number may be as few as 15 or 20 in such a form as *Gambusia*. The sticklebacks, we find, may in some instances have quite as few. Anadromous and marine species, on the other hand, often exhibit the most surprising fecundity. The female shad, for instance, may have 250,000 ova in process of maturation at one time in her roes; the rock-fish or striped bass upwards of 3,000,000; the cod from 2,000,000 to 9,000,000; the pollock 4,000,000; the haddock not far from 2,000,000. These are significant figures, and doubtless indicate that there is some principle or law regnant in nature which determines these wide differences in the number of ova matured by one female in a single season. It may be a fact that the eggs of the cod and many other species have been gradually adapted to float, because, if they did not, the pressure of the water at great depths would prevent their development. In spite, however, of this admirable provision, it is doubtless a fact that one egg of a nest-building species, like the stickleback, has a thousand chances favorable to its survival as against one in favor of a single egg of the cod, left as it is floating in the open sea at the mercy of wind and waves. The species with thread-bearing eggs seem to a certain extent intermediate as regards the number of ova produced, and this is perhaps as strong an argument as can be produced, tending to show that the filaments are developed as protective contrivances, which suspend such ova in safe positions to fixed objects above the sea-bottom during their development.

WASHINGTON, D. C., *June* 11, 1883.

18.—DO SNAKES CATCH AND EAT FISH?

By WILLARD NYE, Jr.

[From letter to Prof. S. F. Baird.]

While up on Lost Creek, yesterday, I saw a snake coming out of the water with a fish in his mouth, that he had caught all by himself. The snake was one of these common kind seen around pounds, and about 30 inches in length, while the fish was about 4 inches long (but thick and bulky), being what they call out here a "bull-pout" (looks just like a toad-grunter from the salt water, and live under stones the same as they do). I killed the snake, and the fish being alive, put him back in the water, when he went off seemingly much pleased at the change.

A friend who was with me also found a snake which had swallowed one of the same kind of fish; that is, he had got him down as far as the gills, and the fish was still alive. The idea of a snake going in for a morning's fishing struck me as rather funny, so thought I would send you an account of it.

PARK CITY, *June* 25, 1883.

19.—DIRECTIONS FOR COLLECTING AND PRESERVING FISH.

By TARLETON H. BEAN.

1. Wash the fish thoroughly in water to remove the slime and dirt that are almost invariably present upon them, not omitting the inside of the mouth and the gills. In cleansing fish that have a tough, scaleless skin, or such as have the scales firmly fixed, use a stiff paint brush or a scrubbing brush; for thin-skinned fish and such as have deciduous scales a softer brush must be taken. Some fish are covered plentifully with tenacious mucus that is with great difficulty removed by water alone; in such cases a solution of two tablespoonfuls of alum in a pint of lukewarm water will be found efficacious.

2. It is often necessary to preserve fish that are stale, or partially digested, and offensive to the smell. Such examples may be thoroughly disinfected by the use of the disinfecting solution of chloride of soda. Use a tablespoonful of the solution in one pint of water. With this wash the gills and pour it into the mouth and stomach, allowing it to return by the mouth.

3. Inject alcohol in the mouth and the vent to preserve the viscera. Make small incisions in the belly and in thick parts of the body to allow the alcohol to penetrate the tissues. It is often necessary to remove the liver, stomach, and intestines from large fish and to preserve these separately, numbering them so as to correspond with the fish from which they are taken.

4. It is a good plan to keep freshly collected fishes in weak alcohol for a day or two; a mixture of two parts of 95 per cent. alcohol to one of water will answer for this temporary immersion. Some species are exceedingly soft and flabby, falling to the bottom of a glass jar or other receptacle, becoming partly imbedded in their own mucus, and rapidly disintegrating in consequence. Such specimens should either be suspended in the alcohol by a thread or string from the neck of the jar or the hook sometimes found on the inside of the stopple, or a bed of excelsior or muslin should raise them from the bottom; these are necessary precautions which will prevent many losses. After the fish have been kept for not more than two days in the weak alcohol, transfer them to a mixture of three parts of 95 per cent. alcohol to one of water. Ordinarily this latter will preserve specimens that are not crowded too much at least three months; some, of course, will remain in good condition still longer; but, generally, three months will reduce the preservative power of the liquid so far as to make a renewal of alcohol necessary. The tendency with many collectors is to overcrowd specimens, and, as a result, museums frequently receive a lot of half-rotten material which is too valuable to be thrown away and is yet always a source of trouble and disappointment. A jar, tank, or case of any kind should never be

expected to accommodate more than half its own bulk of fish, and even this proportion will require watchfulness to avoid loss. If a collection freshly caught is to be shipped to a distant museum or private collection, observe the directions about cleansing the fish and preserving the viscera separately if needful, and then use nothing weaker than a mixture containing three parts of 95 per cent. alcohol and one part of water. A good mixture which will carry fish in very nice condition is the following: 95 per cent. (or absolute) alcohol, 3 quarts; water, 1 quart; glycerine, 1 pint; borax, 1 ounce. There is nothing better, however, than the mixture of three parts of alcohol and one of water.

5. The extensive collections of the United States Fish Commission are usually packed in copper tanks, which are tin-lined within. The lid of the tank is made to screw in the top, and its diameter is always as great as the dimensions of the top will allow. The tanks (called Agassiz tanks) are made to contain 4, 8, or 16 gallons. Strong chests, of a size large enough to accommodate a 16-gallon tank, are used for shipping; the hinges and hasps of these chests are riveted on; handles are screwed on at the sides, and each chest is furnished with a strong lock. The chest may contain one 16-gallon tank, or two of 8 gallons, or four of 4 gallons, or one of 8 gallons and two of 4 gallons, as may best suit the convenience of the collector. When several tanks make up the complement it is usual to separate them by thin wooden partitions.

Cases made of ordinary tinned sheet-iron are much more generally used than the expensive copper cans, and they will answer well enough if the joints are perfectly tight and the top is securely soldered on.

Oak kegs, holding about 10 gallons each and provided with iron hoops, are capital containers for large fishes, and they will stand the wear and tear of railway travel better than most other receptacles.

Glass preserving-jars may be shipped long distances with comparative safety, but they must be tested, by inverting them, to insure tightness; the top of the jar and the rubber band should be wiped dry; wrap the jars in strong paper and pack them in some material that will prevent breakage.

When corked bottles are used, tie a piece of bladder securely over the cork. Where seals and sea-lions occur, the throat, as prepared by the Aleuts for example, will be found an excellent covering. It is necessary to wet the membrane to make it pliable. Whenever jars, bottles, or any other small containers are filled with fish which are not provided with tin tags, write plainly with a lead-pencil on heavy manila or writing paper the name of the place where the fish were taken, the date of capture, and the name of the collector. Put a label of this kind inside of each bottle; it will remain legible for years.

6. Each specimen should be provided with a numbered tin tag, which is to be fastened, whenever possible, by means of a string passed through the right gill-opening and out at the mouth. When the string *must* be tied around the body or tail of the fish it should be fixed securely and

yet without injuring any of the fins. A catalogue is to be kept by the collector, in which the numbers corresponding with those on the tags must be entered, with notes as to place, time, and mode of capture, and other particulars which will be more fully mentioned further on. Wrap each fish separately in common coarse muslin (the coarser the better), and tie the ends securely. Do not tie the string so tightly around the body of the fish as to make furrows and wrinkles in the skin. If tin tags are not at hand, a label written firmly on stout paper with a lead-pencil should be wrapped inside of the covering of the fish. It is necessary always to fill the receptacle in which specimens are packed—a bottle or jar may be either filled with alcohol or the specimens may be wrapped in muslin. It is not a good plan to put tow, excelsior, or cotton-wool on top of fish, as it presses them close together and prevents the free circulation of alcohol between them. For long journeys it is desirable to secure better protection than the muslin wrapping alone affords. This may be gained by placing beds of excelsior or thin wood shavings between the layers of fish and at the bottom and top of the case.

A plainly-written card placed at the top of the box, so as to be seen when the lid is removed, telling its contents and by whom it was sent, will save much trouble when the collection is to be unpacked.

7. Notes of color, taken from the fresh specimens, should be sent with them if the fish are to be described in the museum. The collector should also preserve in his own books a record of life-colors under the catalogue numbers corresponding with the tin tags fastened on his fish. He can then obtain the identification of his species by their numbers and publish his studies upon them at his own pleasure.

8. Local names of fish should always accompany the specimens when obtainable.

9. It is desirable to know whether or not the species is abundant; whether different sizes of the same fish are found; whether they associate in schools or not; whether they are permanent residents or migratory; if migratory, by what routes they come and go; whether they form an important article of food; what they feed upon and what species prey upon them; the depth and character of the bottom on which they occur; the mode of capturing them; the uses made of them and the various products which they go to form, in short, everything bearing upon the life history or the economic applications of the species should be noted in detail.

10. Before washing the fish look them over for external parasites; examine the gills and the inside of the mouth carefully, as these are favorite situations. These parasites often furnish a clew to the migrations of the fish; remove them if they can be taken off entire, if not, let them remain, and call attention to their presence in your shipping notes. Preserve the parasites in vials or bottles, and provide them with labels stating from what fish they came and in what situation they were found.

To preserve fish indefinitely in glass jars, observe the following directions: first, select a jar of the proper size to accommodate the specimen amply, without bending or distorting it in any way; put in the fish with the tail down in nearly all cases; the tail may often rest upon the bottom of the jar, or the fish may be suspended from the hook which is now found in the stopple of the modern museum jars; cover the fish completely with the alcoholic mixture referred to in the closing sentence of paragraph 4; discoloration of the alcohol is a sign that its preservative power is weakened and calls for a renewal; fishes in alcohol will never make a good show unless the liquid is kept clear and clean. A label giving the name of the fish, place of its capture, and name of its captor, should be tied on the neck of the jar by means of a piece of narrow tape passed through holes punched in the ends of the paper. The jars must have accurately ground glass stopples. It is best to use no kind of sealing wax to coat the joint of the stopple; simply wipe the glass perfectly dry, close the jar properly, and there will be little danger of evaporation. Do not let the direct sunlight strike your jars, and keep them well removed from stoves, registers, and the like.

NATIONAL MUSEUM, WASHINGTON, D. C., *December*, 1881.

20.—PLANTING AND CATCH OF SHAD IN COOSA RIVER, ALABAMA.

By CHAS. W. SMILEY.

A report of the number of shad taken at Wetumpka, on the Coosa River, has been received from Mr. Cabot Lull, which is as follows: In 1879, 1,000; in 1880, 600; in 1881, 55; in 1882, 35; in 1883, 22. These fish were caught in eight traps at that place.

Concerning this report, which was forwarded by Mr. T. S. Doron, of Montgomery, Ala., the latter remarks: "I think it is as accurate as can be obtained. Mr. Lull seems to think that the shad had disappeared. I know that the rise in the water has prevented the catch of shad during the past three years. Those caught last year were large fish, some weighing four pounds each."

In connection with the above it is interesting to know what deposits of young have been made in this vicinity by the United States Fish Commission. The deposits in 1876, 1877, 1878, and 1879 were as follows:

July 11, 1876, in Alabama River at Montgomery	90,000
May 29, 1877, in Tallapoosa River at Montgomery	75,000
June 9, 1878, in Tallapoosa River at Salisbury	50,000
June 13, 1879, in Coosa River at Lebanon	45,000

In 1880 and 1881 there were no deposits made.

UNITED STATES FISH COMMISSION, *May* 14, 1883.

21.—REPORT OF INVESTIGATIONS AT NEAH BAY, WASH., RESPECTING THE HABITS OF FUR SEALS OF THAT VICINITY, AND TO ARRANGE FOR PROCURING SPECIMENS OF SKELETONS OF CETACEA.

By JAMES G. SWAN.

I left Port Townsend, Wash., on the 26th of March, 1883, for Neah Bay, at the entrance of the Strait of Fuca; and arrived there the next morning, the distance being about one hundred miles. My object was to make arrangements for procuring skeletons of marine mammals, such as whales, orca or killer, porpoises, etc., and to study as far as practicable the habits of the fur seals of Cape Flattery, in order to ascertain in what respect, if any, they differ from the fur seals of the Pribloff Islands, Alaska.

I had been informed that the Indians had towed the carcass of a large sulphur-bottom whale, *Sibbaldius sulfureus* Cope, into the mouth of a small stream, a few miles east of Neah Bay, where it had grounded at high water, and at the lowest run of tides was entirely exposed.

The Indians had removed the blubber and flesh and had left the bones, but had cut the lower jaw in pieces to extract the oil, and had injured the skull so that the skeleton is not perfect. The weather being boisterous, and the tides not running low in the daytime, I did not have opportunity to examine the bones, but was assured by the Indians that the salt water and marine animals had cleaned them so that they are perfectly white—a statement of which I took advantage by pointing out to the Indians how easily they can clean the skeleton of an orca, by towing the body into some rocky cove, where it would not be buried in sand, and leaving it for a few months in the salt water. As the Makah Indians kill the orca during the summer months, particularly in the vicinity of Flattery Rocks, I think I may be able to secure a good specimen this summer.

The sealing schooners being all in port I took the opportunity to ask questions of both white men and Indians, and have reduced their answers to writing, as nearly as practicable in the language used by each person.

March 28. Went to the trading store of William Gallick to make inquiry about the habits of fur seals. Mr. E. Gallick, trader, says: "I have been engaged in trading here for fur seal skins for about six years. It is the general impression and belief among the sealers, both white men and Indians, that the fur seals do have pups in the ocean. Some persons say they go north to the Pribloff Islands, but others think these seals come from the south and do not go into the Bering Sea at all. I have shipped fur seal skins to London where they brought a better price than those from the Pribloff Islands; the fur is longer on the Cape Flattery seals and of better color. I have no means of information where

these seals have pups, but I do know that every season, towards the close, some years in June and in other years July and August, there are plenty of young pup seals taken with their mothers. The Indians invariably kill the pups when they can, as their bleating cries alarm the older seals, who will keep out of the way of the hunters. Young seals taken alive from their mothers are a matter of every day occurrence in June and July. These young seals are strong and lively, and will swim as soon as taken from out of their mothers. I had one brought to me last summer by one of our sealing schooners. I fed it with milk from a nurse bottle, and it grew finely. I kept it in the yard, and it would swim round in a tub of water, and I used to take it to have a swim in the bay. It was very tame, but one day it bit me severely and I told an Indian to kill it."

March 29. I went to the house of Captain John, an old chief, now blind, and met there *Quistoh*, or *Kwistoh*, a chief of the Nittinat Indians on west coast of Vancouver Island, B. C., and Cedakanim, a chief of the Clyoquot Indians, northwest of Barclay Sound, B. C.

Captain John says: "The fur seals have their young ones in the salt-water, but I don't know were. The hair seals (*Karschowe*) have their young ones in the caves about Cape Flattery, but the fur seal (*Kaithladoos*) somewhere on the ocean. The Indians think they have them on the kelp beds, like the sea otter."

Kwistoh says: "Many years ago, my father and some other Nittinats were blown off to sea in their canoes; they went a great way off, a great way toward the setting sun. It was warm weather, about your 4th of July, I think; they saw many fur seals; the sea was full of them, and they had their little pups with them, and the little ones made so much noise that the Indians could not kill any of the big ones. We all think the fur seal (*Kaithladoos*) has its young ones born in the water."

Cedakanim says: "We think the fur seal has its young ones in the ocean, but I don't know where. I know the old seals by the color of their whiskers, and I know the last year's pups, and I know the little pups, which come with their mothers, which are too small to be good fur. Where do these little seals come from? I don't know, but I believe, as all the Indians do, that they are born in the water or among the kelp."

Peter, chief of Makah Indian police, says: "The fur seals all come from the south. In the spring they are plenty, but when the hot weather comes they go off west; but they do not all go, because fur seal can be seen all the time along the coast, but they are shy, and we don't hunt them. I don't know where they have their young ones, but there are plenty of little seals here every summer."

March 30. Youaithl, or old doctor Makah, residing at Neah Bay, says: "We all think the *Kaithladoos* (fur seal) has young ones in the water. I have killed many fur seals with young ones in them, just ready to be born, but they were no good, and I generally knocked them on the head,

but I have thrown plenty overboard, and they always swim as soon as taken from their mothers, when they are ready to be born, say about June or 4th of July. The hair seals (*Karschowe*) have their young ones in the caves about Cape Flattery. The Indians go in the caves with torches and clubs, and kill the seals. We eat the meat and use the skins for buoys (*Dó-ko-kuptl*), and make oil out of the fat. The fur seal (*Kaithladoos*) don't go in the caves, they have their young ones in the water or on the kelp, like the sea otters (*Tejuck*). We think the fur seals come here from California."

March 30. *Ko-ló-whad*, or Billy Buster, says: "I have been to Alaska, on schooners, hunting sea otter. I have been to Saint Paul's Island and seen the fur seals on the land. They are different from the seals here, for they have their young ones on the land, and the fur seals of the coast have their young ones in the water. I have seen them in August off in the ocean, I think one hundred miles southwest of Cape Flattery, lots of them with their little ones playing around them, but they are very shy then, and the young ones make such a noise that canoes can't get near them. It is about the time the seals have their young that the seal fishery at the cape is stopped. I am quite sure that these fur seals act different from those on Saint Paul's. I think they come from California, and I don't believe they go to Saint Paul's Island. The Indians all say that the fur seals have young ones in the water like sea otter do."

This last Indian I have known personally many years. He speaks good English, has been several voyages on vessels for sea otters, has been to the Pribloff Islands, Bering Sea, Okhotsk, and the coast of Japan, and is a good otter hunter, as well as seal hunter, is intelligent, and well informed about the habits of marine animals.

April 2. Capt. James Dalgardno, of sealing schooner Mary Taylor, says: "Little seals are very plenty towards the close of the season, which varies. Some years the seals leave about the 20th of June, other seasons not till the last of July. But the fur seal is plenty about 100 miles off the cape in August. I have seen hundreds of pups cut out of their mothers apparently just ready to be born; they would scramble around on deck and make a cry like new-born lambs. I have thrown lots of them overboard, and they invariably swim as soon as they get into the water; it is all bosh about pup-seals sinking like a stone. If the seal pups at Saint Paul's Island can't swim as soon as they are born they must have different habits from the seals here, because I have seen so many of them swimming after they had been taken alive from their mothers' wombs. Every sealer, both white men and Indians, know about seal pups as well as I do, and they know that my statement is correct."

April 11. After my return to Port Townsend, one of the sailing schooners, the Champion, Capt. E. H. McAlmond, came up from Cape Flattery, and, in an interview in my office this day, Captain McAlmond says: "In the latter part of June, 1882, while cruising 40 or 50 miles

off Cape Flattery, about southwest, I saw a thick bed of kelp about which fur seals were playing. I noticed one in particular, a female, on this bed of kelp. Her actions indicated that she was about to give birth to a pup, as she paid no attention to us, but kept moving about as if she was making a bed. After watching her a while I sent a canoe, and the Indian killed the seal and brought it on board. On opening it the young pup was taken out alive and it traveled about the deck, raising itself on its fore flippers and making a bleating cry. It was perfectly formed and there was every evidence from the appearance of both the mother and the maturity of the pup that it would have been born on that bed of kelp in a very short time if we had not disturbed the mother. The Indians carried the pup ashore, where I saw it alive several days after. I tried to buy it, but they refused to sell. I have no doubt that if this pup had been properly fed and cared for that it would have lived to have grown up to maturity. I have had many years' experience in the sealing business at Cape Flattery, and every season at its close the young pups are plenty. I think, as the Indians do, that these pups are born in the water or on kelp beds. My opinion is that the fur seal of the cape come from Lower California, and that they do not go to the Pribloff Islands. I think their habits are different from the fur seals of Saint Paul's."

The following extracts are from letters to me from Alexander C. Anderson, esq., inspector of fisheries, British Columbia:

"I note what you say about fur seals. It is very desirable that the discrepancy between the statement of Mr. Elliott, and the accounts of local observers should be reconciled. Mr. Elliott is very dogmatic in his statements, and certainly treats your remarks with scant courtesy. I hope you will renew the subject and discuss it at large from our local point of view. The true solution will, probably, be as you suggest—that our seals are of the southern variety and quite different in habits from the northern species. Mr. Elliott, however, argues under the assumption that our seals are only a detachment from the northern herds, and dovetailing all his observations to correspond.

"VICTORIA, BRITISH COLUMBIA, *June* 24, 1882."

"I have not yet procured the information I desired about the fur seals, but will attend to it as soon as opportunity serves, and will let you know the result. I think everything will appear to sustain your opinion.

"VICTORIA, B. C., *August* 24, 1882."

"I have spoken with Captain Warren and Captain Spring, both largely engaged in the seal trade, concerning the pupping of seals. The former of the two appeared to be reticent, and I do not think has been a close observer, so far as the natural history of the seal is concerned. He could tell little or nothing to settle the pup question. Captain

Spring, a very intelligent man, assures me that he has seen the young taken from the womb frequently in a very advanced state, and that on one occasion he witnessed the taking of a live young one from the womb of a mother seal killed, evidently, within a few hours of parturition. This pup survived about 24 hours, being kept on board in a tub of water wherein it appeared to swim quite naturally. He is convinced that under natural process this pup would have been born within 24 hours of the time when the mother was killed, and is quite incredulous as to the assertion that if born at sea it must sink, as has been asserted.

"VICTORIA, B. C., *September* 15, 1882."

Port Townsend, April, 22, 1883. Capt. Charles Willoughby, an old sealer and fisherman, and recently United States Indian agent at Neah Bay, says: "The fur-seal pups are very common at Neah Bay every season. Last summer, July, 1882, 'Young Sial,' a Makah Indian, killed a female seal and brought it ashore in his canoe. He opened it in the canoe and took out a live pup which, I think, from its appearance, would have been born in a very few hours. It was very lively, and 'Sial' tied a string to one of its flippers and threw it overboard, where it swam round in a playful manner. Sial took the end of the string ashore, where his boy Luke, one of the school-boys, held it. I saw Luke with four of these fur seal pups with strings tied to them, playing just outside the surf. The assertion that they will sink is all nonsense; every Indian and every white man who has lived at Cape Flattery knows that fur-seal pups will swim as soon as they are born. I have seen fur seals hauled out on the Farallones where they had pups. I put one of those pups into the surf, but it did not live; the water was all foam and it did not have a good chance. I think the fur seals about Cape Flattery come from Lower California; their habits are different from the seals of the Pribloff Islands, and they have better fur. I was Indian agent at Neah Bay over four years, and I have had ample opportunity of observation, and it is a common sight every season to see boys have fur-seal pups, with strings tied to them, swimming in the bay just outside the breakers or in the brook at the agency."

This statement of Captain Willoughby about Indian boys tying strings to fur-seal pups and letting them swim in the brook and bay I can corroborate, having, during a period of sixteen years, observed the same thing myself frequently every sealing season.

April 22. Mr. Henry Landes, formerly trader at Neah Bay and dealer in furs in connection with the Alaska Commercial Company, and now president of the First National Bank in Port Townsend says: "I have traded in furs many years, particularly seal and sea otter skins. I know the fur-seal skins of the Pribloff Islands, and the fur-seal skins from Cape Flattery; the Cape Flattery seal has the handsomest and longest fur, and used to bring the highest price in the London market, but the Indians of late (1883) have pulled and stretched the skins and

allowed so many to get what we call pinky that their value has decreased. The seal from Saint Paul's and Saint George's Islands being selected young males, are more uniform in color and match better when made into robes, but the fur is not as good as the Cape Flattery seal. I have never been interested to learn where the fur seals of the cape have their pups; but I do know that they are very common and plenty every season, but are of little or no commercial value. I think the fur seals of the cape come from Lower California, and I think they do not go to the Pribloff Islands. There is certainly a difference in the habits of the seals at each place which I should like to have explained."

Port Townsend, April 25, 1883. Mr. Marsilliot, the second engineer of the United States revenue steamer Wolcott, in an interview in my office this evening, says: "In 1881 the fur seals were very plenty in Puget Sound, and were taken as far inland as Hood's Canal. Sometime during the summer, I think about the middle of June, while the cutter was at anchor in Port Townsend Bay, one of the quartermasters, Mr. Quinn who is now master of the sealing schooner Teazer, saw a little fur-seal pup swimming alongside the vessel. He caught it and brought it on board where we kept it several weeks. It was about the size of a full-grown kitten when Quinn caught it. We fed it with milk, both fresh and canned, and it became a great pet with the men, who used to let it go overboard every day to swim, and it came back regularly to the gang-way ladder to be taken on board. On one occasion the cutter was absent a day, and when we returned to our anchorage the little pup came back and was taken on board again. It was very tame. At last, one day, when the seal was having a swim, the cutter was ordered off, and we were absent a week, on our return the seal was gone and we saw no more of it. The mother had probably been killed at the time the pup came alongside the vessel at first, as there were several fur seals shot in the bay and from the wharves. I have been to the Pribloff Islands and have had some observation of the habits of the fur seals there. I think the fur seals here and at the cape have different habits from the northern seals. I think these seals belong to the herds seen about the Gulf of Tehuantepec and along the Mexican coast. The fact of the pups swimming as soon as born—and even those that have been taken alive from their mothers before they were born, swimming readily—is too well substantiated to admit of doubt. The fact, which Mr. Elliott states so positively, that the pups of the fur seals of the Pribloff Islands will sink like a stone, is an evidence to my mind that these seals differ from those in Bering Sea."

The foregoing statements show the prevailing opinion of both white and Indian sealers, and white persons who have lived at Neah Bay and have had opportunity of frequent observation, that the fur seal of Cape Flattery come from Southern California, and have pups on the ocean and on the kelp beds, a statement which is supported by the testimony of white men and Indians, that they have seen the young fur-

seal pups taken from the womb of the mother, and swimming as soon as put in the water.

I could get plenty of other reliable persons to testify to the fact of the seal pups being plenty in June and July at Cape Flattery, and that they can swim as soon as born. Enough, however, has been given to substantiate that fact, but what remains to be shown is where these fur-seal pups are born. The very short time I was at Neah Bay was not sufficient to ascertain from personal knowledge or observation. I should have remained there through the season, or till the first of July, and have made frequent excursions on the sealing schooners in order to enable me to examine fully the question.

The supposition of Mr. Elliott, that all the fur seals of the North Pacific go to the Pribloff Islands, is of the same kind of popular assumption that all wild geese go north to breed in the Polar seas; and yet Colonel Goss, the great ornithologist of Kansas, found the nests and eggs of the wild geese in Wyoming Territory, and Mr. Elliott may ascertain, if he will, that all the fur seals in the Pacific Ocean north of the Equator do not visit the Pribloff Islands.

I do not consider this report other than as a preliminary brief, to be followed up and further investigated as occasion may offer. The only point I consider definitely settled is that the pups of the fur seal at Cape Flattery swim as soon as born, or even when taken alive from the womb of the mother seal; and in that respect they essentially differ in their habits from the fur seals of Alaska. This question regarding the natural history of the fur seals of Southern California is one of interest, and I hope it may be fully and thoroughly discussed.

PORT TOWNSEND, WASH., *April* 29, 1883.

22.—REPRODUCTION OF CALIFORNIA SALMON IN THE AQUARIUM OF TROCADERO.*

By Messrs. RAVERET-WATTEL and BARTET.

On the 25th of October, 1878, the aquarium of Trocadéro received from the National Society of Acclimation 1,000 eggs of the California salmon (*Oncorhynchus quinnat*), being a portion of a consignment made by Prof. Spencer F. Baird, Commissioner of Fisheries of the United States. These eggs, which were already at an advanced stage of development, hatched very soon. The fry were very vigorous, and their growth was quite rapid, at least from the period (January 1, 1879) at which the aquarium was transferred to the municipal administration and intrusted to the care of a superintendent of roads and plantations

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* *Sur la reproduction du saumon de Californie, à l'aquarium du Trocadéro; par MM. Raveret-Wattel et Bartet.* In *Comptes rendus hebdomadaires des Séances de l'Académie des Sciences.* Tome XCVI, No. 12 (19 Mars, 1883). Paris, 1883, pp. 796–797.—Translated by MARSHALL MCDONALD.

in the city of Paris, by whom attention was regularly given to the different fishes which occupied the aquarium.

Being liberally fed with the flesh of fish minced fine, the young salmon attained in the space of a year a mean weight of 250 grams. At this period almost all had lost the markings of their early age, and had taken on the beautiful silvery appearance of smolts; but they did not manifest that anxiety which is generally observed in our common salmon of the same age when kept in captivity. They bore their confinement perfectly well, and the losses were comparatively small.

Two years later these salmon had become very fine fish. Some weighed as much as 2 kilograms. In October, 1881, several of them gave evident signs of maturity. Artificial impregnation was attempted; but the eggs obtained appeared badly developed and did not give any result. Moreover, all, or almost all, both males and females, which had appeared disposed to spawn, died.

The following year, 1882, also in the month of October, the desire of spawning manifested itself anew in these fish, and on the 24th of October several females yielded about 1,500 eggs, which we attempted to fecundate with the milt of the trout, because there were no ripe male salmon at this time. The experiment did not succeed; but a few days afterward, individuals of both sexes being in full spawning condition, there were collected and fecundated in the space of five weeks about 30,000 eggs.*

Unfortunately, the want of sufficient apparatus for hatching necessitated the crowding of the eggs for several days in a very restricted space. Moreover, the work of repairs in the water conduits which supplied the aquarium permitted the use for some time of only unfiltered water. To these two causes is to be attributed the bad success with a large number of the eggs, which from their fine appearance it is thought should have almost all reached the period of hatching.

About 1,500 very vigorous fry were, however, obtained, and are now in perfect condition. This suffices to demonstrate the possibility of rearing and of effecting the reproduction of the California salmon under conditions of captivity entirely exceptional. This fact is the more interesting as it relates to a foreign species essentially migratory, which has been at the same time transported to a new climate and subjected to a complete change in its habits. It seems, therefore, that we may readily effect the acclimation of this species, and this is particularly desirable with reference to the stocking of the water-courses tributary to the Mediterranean, in which the ordinary salmon is unknown and would not probably succeed. The California salmon extends in America to the thirty-fifth degree of latitude, that is to say, much more to the south than the *Salmo salar*, and could be undoubtedly acclimated in the Rhône, the Aude, the Hérault, &c.

* The individuals which spawned died at once.

Vol. III, No. 14. Washington, D. C. Sept. 3, 1883.

23.—A NEW FISH-HATCHING APPARATUS.*

By von LA VALETTE ST. GEORGE.

The progress which has been made in the culture and care of fish in our waters has caused the invention and application of many different kinds of apparatus for the further development of artificially impregnated eggs.† Much as they differ from each other in form, the most important variation in their construction is this, that, in some, the water which moistens the eggs (which are spread on a sieve-like frame) is introduced from the top, and, in others, from the bottom.

During an experience of more than twenty years I have tried all the different apparatus which I could obtain, both old and new, and with all of them—Jacobi's hatching-box, Coste's hatching-apparatus, Kuffer's hatching-pot (which cannot be too highly recommended), and troughs made of wood, sandstone, cement and granite—I have attained my object, if the principal condition for successful hatching, a sufficient quantity of clear water of the right temperature, was fulfilled; although the California principle of introducing the water from below, on which Von dem Borne's and Eckardt's ingenious apparatus are based, may deserve the preference.

Aiming at the removal of some noticeable defects, caused by too complicated a construction or unsuitable material, I constructed, two years ago, after numerous experiments, a new hatching-apparatus, which I have practically tested during the last two winters. The object which I had in view was to obtain an apparatus as comprehensive, simple, and handy as possible as to its form, and made of a material which would not be affected by the hatching-water, and would not favor the injurious development of fungi. The form is, in its main features, that of the "hatching-bucket," described in the circulars of the German Fishery Association for 1879, p. 107, and the material used is faience.

I shall give a brief description of this apparatus, which, in its construction, offers no technical difficulties whatever, and which I hope will not only prove useful to the practical pisciculturist but also prove a valuable aid in the prosecution of embryological studies.

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* "*Ein neuer Fischbrutapparat,*" von v. la Valette St. George. Bonn, 1882. Translated from the German by HERMAN JACOBSON.

† Commencing with its number for October 15, 1881, the "*Bayerische Fischerei Zeitung*" contains a long and highly valuable historical and critical article on "Hatching-apparatus for Salmonidæ," &c., from the pen of one of our foremost pisciculturists, Mr. F. Zenk, president of the Lower Franconia Fishery Association, in Würzburg.

It consists of two vessels, one fitting in the other. The outer one is of cylindrical shape, 26 centimeters deep, and measuring 30 centimeters across. The upper edge protrudes 1 centimeter.

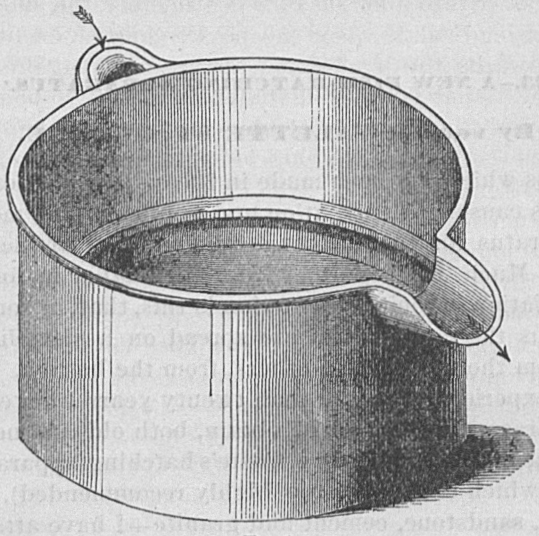

FIG. 1.

On the outside a tube is fastened, which widens into a funnel at the top and serves for admitting the water; its diameter is 6 centimeters, and just above the bottom of the vessel it communicates with the interior by means of an opening 5 centimeters wide. Opposite the inflow-opening the edge of the vessel is cut out 5 centimeters and has an outlet

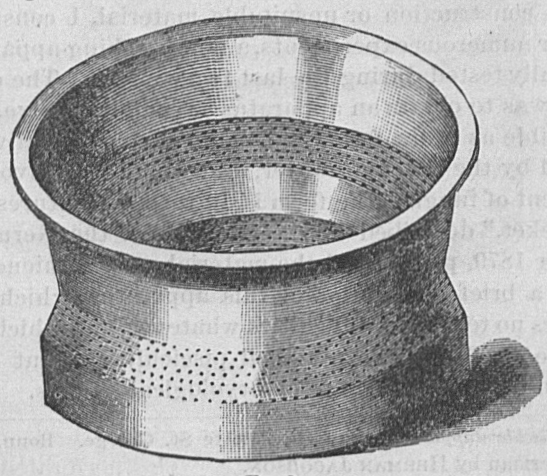

FIG. 2.

8 centimeters broad and 9 centimeters long, which is slightly inclined. Immediately above the opening of the tube described above, and 5 centimeters above the bottom of the vessel, a projecting edge, 1 cen-

timeter thick and 1.5 centimenters broad, runs all round the inner side of the vessel. On this flat edge rests the second vessel, which is 20 centimeters deep, and whose bottom is perforated by numerous very small openings. Up to a height of 5 centimeters the side of the inner vessel rises perpendicularly; for the next 5 centimeters it is inclined 2 centimeters towards the inside, and above this it again rises perpendicularly. The upper edge, 2 centimeters broad, is bent over. The second division of the inner vessel, showing in its section an angle projecting towards the inside, is perforated along its entire circumference, just like the bottom.

The application of this apparatus will easily be understood. Through the tube on the outside the water flows in, entering the bottom of the outer vessel; through the perforated bottom of the inner vessel it enters into this and moistens the eggs, which may cover the bottom to the height of 5 centimeters; the water now goes through the perforated part of the circumference of the inner vessel, and passes again into the outer vessel; but it must rise 5 centimeters higher, in order to flow out through the outlet of the outer vessel. In one minute 3 liters of water can pass through the apparatus.

FIG. 3.

The advantages of this construction will be readily perceived. In the first place the upper frame, which prevents the inspection of the eggs, which easily becomes too tight, and which injures the young fish when they press against it, is dispensed with. The perforated wall of the inner vessel lets as much water flow off into the outer vessel as flows in through the perforated bottom. But as the outlet of the outer vessel is still 5 centimeters higher than the perforated ring of the inner vessel, and consequently there must still be a depth of water of 5 centimeters

above this, there is no current towards the perforated ring of the circumference; and the young fish are not exposed to any injury, especially of the umbilical bag, by being driven against the sides of the vessel, which danger is in other apparatus averted by large and inconvenient sieve-like frames.

What are known as "catch-boxes" (*Fangkasten*) are entirely unnecessary, as the fish which may happen to slip out have still above them a

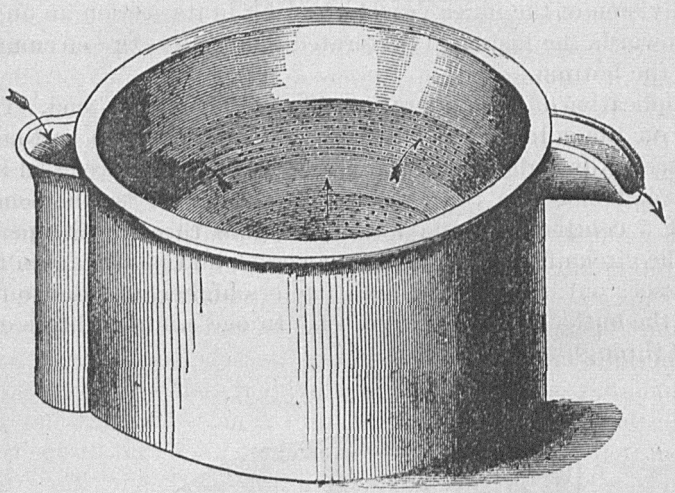

FIG 4.

space 5 centimeters in height, free of water, and there is therefore no chance whatever of their escaping. Unless, for some special reason, it is deemed desirable to place them in a larger body of water, the fish may safely be left in the apparatus till they are fully developed.

Although this apparatus can easily hold 5,000 eggs, it takes up very little room, is clean, and easily handled.

By lifting and pressing down the inner vessel the eggs can easily be moved for the purpose of picking them over.

It is true that faience, like so many of our household utensils, is fragile. If, therefore, the person who is to handle the apparatus suffers from chronic clumsiness, it may be constructed of tin, wood, stone, or cement.

This hatching-pot cannot be considered expensive, certainly not more expensive than other apparatus of this kind, as it may be obtained at the reasonable price of 10 marks ($2.38) from the porcelain and faience factory of Ludwig Wessel, in Bonn.

94.—ON EXPERIMENTS, BEGUN IN 1880, TO PLANT AMERICAN OYSTERS IN THE WESTERN BALTIC, AND THE USEFULNESS OF CONTINUING THESE EXPERIMENTS, WITH THE AID OF THE GERMAN FISHERY ASIOCIATION.*

By K. MÖBIUS.

At several points on the Baltic Sea, the Greifswald Oie (southeast of the island of Rügen), Warnemünde, and Kiel, various attempts have been made during the last forty years to cultivate the European edible oyster (*Ostrea edulis*, L.), but all without success. The oysters which had been planted did not propagate, but pined away and finally died.

Thousands of years ago, when the inhabitants of the Cimbrian peninsula had no other weapons and implements but those made of stone and bone, oysters must have been frequent in the Little Belt, for at a place on its western coast, near the village of Süderballig, between Hadersleben and Apenrade, there is a kitchen-midden from the stone age, which, besides many common edible mussels and heart-mussels, contains numerous oyster shells. It is evident that the oysters once contained in these shells were not brought from a distance, but had been caught in that neighborhood. The circumstance that at one time there were oyster beds in the Little Belt proves that in those times the water of the Western Baltic must have been salter than it is now. In still earlier times, when the Baltic was not confined within its present limits, but covered a considerable portion of its shore-regions, oysters were found still farther from the two belts, east and south of Kiel, in places which are now 300 to 600 meters above the water-level. The bottom of the Baltic, therefore, has risen in course of time, and so the straits connecting it with the North Sea, the Sound, and the two Belts have become shallower and narrower, in consequence of which the amount of salt water received by the Baltic from the North Sea has decreased, and no longer counterbalances the fresh water which continually pours into it from its tributary rivers. It is certain that the change of the water of the Baltic was a very slow process, which possibly is still going on. Our descendants will be able to determine this question, as by the investigations of Dr. H. A. Meyer, and the German commission for the scientific exploration of the German seas, the present degree of saltness of the water of the Baltic has been accurately ascertained. The oysters of the Süderballig kitchen-midden are smaller than those of the same age from the oyster beds on the west coast of Schleswig (as the specimens placed on exhibition show). They proba-

* *Über den im Jahre* 1880 *begonnenen Versuch, nordamerikanische Austern in der westlichen Ostsee anzusiedeln und die zweckmässige Fortführung desselben unter etwaiger Beihülfe des Deutschen Fischerei-Vereins.* Translated from the German by HERMAN JACOBSON. From Circular No. 2, 1883, of the Deutsche Fischerie-Verein, Berlin, April 30, 1883.

bly had, therefore, reached a stage of deterioration, when they were eaten by the ancient inhabitants of the regions of the Little Belt.

If the European oyster could live in the present water of the Baltic, it would not have set the limit of its domain near the island of Anhalt, in the Kattegat. That the oysters have been driven from the Baltic by its waters gradually losing their saltness, may be seen from the fact that on the eastern, the Swedish coast of the Baltic, where the water is less salty than in the middle and the western (Jutland) coasts of the Kattegat, they have retired farthest towards the Skagerack.

The most recent attempt to cultivate oysters in the Baltic is principally distinguished from the former failures by the fact that it has been made, not with our European species, which, as experience has shown, cannot live in the Baltic, but with another kind, the North American oyster, *Ostrea virginiana* Lester.

The North American oyster is longer than the European in the direction from the ligament toward the edge of the stomach. In the same direction the impressions of the adductors is, when compared with its breadth, of larger extent, and its fore part is blunter than in our *Ostrea edulis*, and has a more or less of a dark, violet color. The indentation in the left or hollow valve is narrower and deeper than with our oyster; nor does it have the low, wart-shaped teeth, which in the *Ostrea edulis* are found on the anterior and posterior edges below the ligament. The *Ostrea virginiana* grows to the length of one foot (more than 30 centimeters). Like *Ostrea edulis*, it spawns during the warm months. On the coast of Virginia and Maryland, on shallow beds which are more exposed to the rays of the sun, they spawn as early as May, according to W. K. Brooks, and on beds at a depth of 9–11 meters in July. Brooks estimates the number of eggs of a full-grown American oyster at nine millions.* As the eggs do not develop in the beard of the mother oyster, and are therefore not protected by her, as is the case with the embryos of the European oyster, the American oyster needs a greater fecundity than the European, if it is to increase in spite of the manifold destruction of the eggs and young.

The idea of cultivating North American oysters in the Little Belt was conceived by the late engineer, Mr. C. C. P. Meyer, of Hadersleben, who had spent some time in America. When Meyer came to Kiel to communicate to me his plan and ask my advice, I advised him to place oysters on the east coast of Schleswig only in such locations where they could not be covered with mud and sand or by masses of living or dead plants; for the American, like the European, oyster, after it has once adhered to some portion of the bottom of the sea, can no longer move about, and must perish if it is covered with mud, sand, or plants.

Meyer found some persons to join him in his enterprise. A company was formed which obtained permission from the provincial govern-

* W. K. Brooks: Development of the American oyster (*Ostrea virginiana*), in report of the Commission of Fisheries of Maryland for 1880. Baltimore, 1880.

ment at Schleswig to start oyster beds on its east coast. By a special agreement made in March, 1882, the provincial government, with the consent of the minister of agriculture, granted this company the privilege of establishing and using oyster-beds for forty years, within certain limits. During the winter of 1879–'80, Meyer went to America, and brought thence 1,250,000 spat and 5,000 large oysters, which, in quantities of 5,000 to 150,000, he placed at ten different points in the Little Belt, from Knudshoved, near the Danish frontier, as far south as the island of Barso, in the Bay of Gjenner.

Through the kindness of the managers of this enterprise I have twice been enabled to participate in the examination of these artificial oyster-beds—in August, 1880, and September, 1882. In some places nothing was found but empty oyster-shells, and in others, besides empty shells, also living oysters. In those places where the result was most unfavorable, the bottom was either covered with quicksand or with dense masses of dead sea-grass. The best result was obtained south and southeast of the island of Aarò, on firm, sandy, or stony bottom, free from plants. According to a communication from Hadersleben, dated some time in March (1883), many of the oysters placed in the Little Belt are still alive. They have, therefore, lived in the Baltic through three winters, which, however, does not imply that the experiment of acclimatizing the American oyster in the Baltic has been a complete success, for this would require that they also propagate in the Baltic from one generation to the other.

The first time I examined the beds, in August, 1880, I found in the shell of one of the older American oysters a very small live young oyster, which had probably been born in Europe. In September, 1882, I could not discover any signs of propagation. Although this does not show conclusively that the American oyster is not able to propagate in the Baltic, there is, on the other hand, nothing whatever to prove that the American oysters placed in the Baltic will propagate and ultimately form regular oyster-beds. These circumstances induced me to inquire for the causes of their probable barrenness. The shells of the oysters had increased considerably in size as early as August, 1880; they must, therefore, have taken and assimilated a certain quantity of food, sufficient to form new matter for the shell. But none of the oysters which I opened in August, 1880, and September, 1882, had that healthy appearance, which in the Schleswig oysters is termed fatness, and which is caused by the well-developed sexual glands. On the contrary, they were all thin and watery, like old and barren European oysters.

I thought that possibly the saltness and temperature of the Little Belt were not suitable for the healthy development of all the organs of the American oyster, and especially not for the growth of mature eggs.

Unfortunately we know but little regarding the saltness and temperature of the American oyster-beds. The only data which we possess we received from Prof. G. Brown Goode, in Washington, in answer to

a request made by the president of our association. Prof. G. Brown Goode informed us that in the Chesapeake Bay oysters perish, when the saltness, for some time, is less than 1.3 per cent. According to observations made by Dr. H. A. Meyer,* the saltness of the sea-water on the east coast of Schleswig-Holstein only goes below 1.3 per cent. in spring and summer, when large quantities of fresh water are emptied into the Baltic from the rivers and streams. In autumn and winter the percentage of saltness is higher, as much as 2 per cent. and more, in deep places. On the 15th September, 1882, I found a saltness of 1.8 per cent. in the surface-water near the island of Aarò, where the American oysters have been placed.

Wherever the European oysters form natural beds, and also in basins where they are cultivated or kept for the market, the average saltness of the water is greater.

	Per cent.
The average saltness on the Schleswig oyster-beds is	3 to 3.3
Near Whitstable and Herne Bay, mouth of the Thames....	3.1 to 3.2
In the river Roach, southeast coast of England	3.1
In the Bay of Arcachon†	3
In the Ostend oyster-basins	2.9
In the basins of Tremblade, mouth of the Sendre, Western France	2.5

As the North American oyster is found as far south as the coast of Texas and as far north as New Brunswick, it evidently possesses the faculty of accommodating itself to different temperatures. According to Ingersoll,‡ the oyster-beds near New Brunswick are during winter covered with ice. This great adaptability of the North American oyster to sea-water of different temperatures suggests the question whether there are not varieties of it which cannot only stand a low temperature, but also water possessing but a small degree of saltness, qualities which are peculiar to all the marine animals living in the Baltic. The oysters set out near the island of Aarò were selected without any special regard to these qualities. They belong to the variety which is found in the latitude of New York, especially near Long Island. They

* H. A. Meyer: *Untersuchungen über physikalische Verhältnisse der westlichen Theiles der Ostsee.* Kiel, 1871.

† In the *Deutsche Fischerei-Zeitung* for August 1, 1882, J. Boeck says: "In France oysters are cultivated in the mouths of rivers; in Southwestern France, in inlets having brackish water. * * * There is reason to hope that by means of naturalized and acclimatized oysters, oyster-culture may be successfully introduced in our many inlets having brackish waters."

In this connection I would say that the saltness of the water of the Baltic, between Rügen and the Greifswalder Oie, is only .72 per cent.; in the Greifswalder Bodden, .65 per cent.; and in the haffs still less. It appears from this that it is not safe to draw a conclusion, as to the saltness of sea-water from a similarity in the configuration of the coast.

‡ E. Ingersoll: "The oyster industry," in The History and Present Condition of the Fishery Industries, prepared under the direction of Prof. S. F. Baird, by G. Brown Goode. Washington, 1881.

therefore came from portions of the sea having a higher temperature and a greater saltness than the Little Belt, near Aarò. If we wish to continue our experiments, we should select the most northerly variety of the American oyster, and take them from beds where the water has the least degree of saltness which they can stand. Unfortunately, Ingersoll's work on the American-oyster industry contains no data relative to this subject. Here is an opportunity for the German Fishery Association to make some practical use of its connection with North America, by causing more exhaustive investigations to be made in that country.

With this view, the following questions would have to be answered:

1. Are there any oyster-beds on the coasts of New Brunswick, where the water is much less salty than in the open sea, and near what towns are these oyster-beds located?

2. What is the maximum and what the minimum degree of saltness in the water near these oyster-beds?

3. Are these oyster-beds covered with ice every winter, and how long?

4. Could healthy oysters, capable of propagating, well packed, be quickly sent from New Brunswick to Germany in spring, when frosts have ceased?

In the above-mentioned work of Mr. Ingersoll a Mr. Venning* is mentioned as inspector of fisheries in New Brunswick. Ingersoll has also received information relative to the New Brunswick oyster-beds from Professor Whiteaves.† Both these gentlemen, whose residence Ingersoll unfortunately does not give, might possibly aid us in answering the above questions.

For answering the second question, What is the maximum and minimum degree of saltness of the water near these oyster-beds? Observations would have to be made. For these the following instruments would be needed: An aerometer, a thermometer, and a glass cylinder in a solid box which can be easily handled, accompanied by plain and intelligible directions. A set of the instruments, manufactured under the supervision of the commission of scientific investigation of the German seas, can be obtained from Mr. Steeger, of Kiel, for about 25 marks ($5.95).

If these investigations should lead to favorable results, I would recommend to get oysters from New Brunswick in the spring of 1884 and set them out in suitable places on the east coast of Schleswig-Holstein; but a layer of oyster-shells should first be placed on the bottom, as experience has shown that these form the most favorable habitat for young oysters.

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*The reference is doubtless to Mr. W. H. Venning, inspector of fisheries, Saint John, New Brunswick.—C. W. S.

†Probably Professor J. F. Whiteaves, Assistant Director of the Geological Survey of Canada, Ottawa, Ontario.—C. W. S.

25.—FISH-CULTURE IN BELGIUM.

By Hon. E. WILLEQUET.

[Extract from a speech on the subject of the fisheries delivered before the Belgian Chamber of Representatives.*]

There is another point which relates to the fisheries, and which is too important to be treated laterally, and, so to speak, in an incidental manner—I mean the pollution of the water. This is a very serious thing, and should be the object of the immediate attention of the Government and of the Chamber. There take place incredible things, unworthy of a civilized country. The drinkable waters which are used in the manufacture of beer are continually corrupted by chemical and other substances without any of the authorities seeming to notice it. It is a veritable poisoning, and, because it is only spoken of in connection with fish, no attention is paid to a mischief which is in reality very great. This emptying of poison into the water of our rivers certainly exerts a most sad and cruel influence on the public health. Many maladies of which the origin is not known have their source in this pollution which is carelessly, shamelessly, and with impunity practiced in our country.

Yesterday, in considering the subject of agriculture, an honorable member spoke of the necessity of pointing out to our agriculturists new fields upon which they may enter, in view of the revolution produced by the introduction of cheap foreign cereals. It is undeniable at present that the production of cereals should be abandoned in a great measure by our country people, and that there is urgency for them to find another outlet for their activity.

And in this connection let it be permitted to me to point out to the farmers who have lands suitable for being submerged the very general use in Germany of alternating ponds. It is perfectly possible to combine with other rural labors the cultivation of a pond which, every second or third year, can be restored to cultivation, after having served for the multiplication and fattening of fish. This method is excellent for the fields, as by its means the land is without expense furnished with a most excellent manure.

I pass to another field of activity for those who interest themselves with fishery questions. I particularly desire to say something in respect to the mixed fishery—that in the tide-water of our rivers. Heretofore there has been no thought except regarding the fluvial fishery, properly so called—that is to say, the fishery in our rivers and in the streams tributary to our rivers. There is another fishery which occupies the middle ground between the maritime fishery and the fluvial fishery, that which is carried on in the lowest parts of our rivers, in the Escaut and

*Journal of the Chamber of Representatives, April 27, 1883. Translated from the French by MERWIN P. SNELL.

in the Meuse. Now, this is a source of wealth which is most completely slighted, and yet is exceedingly valuable. I could attest by statements emanating from the highest authorities on the subject that, with a slight expense. these water-courses could be peopled at will with excellent fishes. In America this is done every day. The great Commission of Fisheries established by the United States Government has led to positive results, which can be verified at any time, and which, if attained in our country, would permit the stocking of the tide-waters of the Escaut and the Meuse with river herring, shad, and still other fishes.

I mention the shad: we have in our country only an insipid shad, generally disdained—I mean the common shad. But there are others which are sup rior to it; there is one especially, the mere name of which makes one's mouth water—the *Alosa sapidissima.* It is cultivated abundantly in America, and could easily be so in our rivers.

There already exists a treaty between Belgium and the Netherlands in regard to the fisheries of the Escaut. It would therefore be very easy for our Government to act in concert with the Dutch Government. I do not ask, however, that negotiations be engaged in which will absorb very valuable time. I ask that our Government, after the example of what has been done elsewhere, shall take the initiative in this measure, without regard to what is done by her neighbors. Let her engage in a work which will profit her; and should she sow benefits around without deriving any profit herself, she would in that only follow great examples and make an important beginning.

On the subject of this sp cial question of the fisheries, new relations have recently sprung into being between different governments. One notices a reciprocal kindness and disinterestedness and eagerness to oblige which hitherto have not been the characteristic feature of their reciprocal relations. So we may observe to-day between the United States, France, Switzerland, Italy, and England exchanges of fish-eggs and of fry which attest a cordiality most remarkable and most profitable. Not a year passes that the North Americans do not make important shipments of fish in every direction; and they not only make presents of them to other countries, but [sometimes] send persons to accompany each lot to give them all necessary attention, in order that they may arrive at their destination in the best condition. Two recent facts are of a nature to show you how much these new customs are developing.

It is from Switzerland that I draw my first example. There are in this country four piscicultural establishments, carried on under the exclusive dominion of the ideas of which I have just been speaking. A little below the falls of the Rhine, at Schaffouse, is situated the establishment of Neuhausen, in which a very large number of salmon are raised, purely and simply to be put into the Rhine without regard to who will take the fish and profit by them. Not far from it, on the other side of the river, in the canton of Zurich, there are three establishments of the same nature: one at Dachsen, opposite Neuhausen; the second,

a little lower, at Glattfelden; the third at Meilen, on the Lake of Zurich. There, as at Schaffouse, the products are placed in the Rhine and in the lake without any anxiety to know who will be profited by this benefaction. Notice that all these establishments were founded and are carried on at the expense of the cantons. These are examples which I would desire to see followed. I would be charmed to have this happy rivalry establish itself between us and our neighbors, and I hope that no prejudice will arise on account of the sacrifice, really insignificant, which we would have to make. I will add that a good deed never goes unrewarded, even on the earth. There is a natural law by virtue of which the fish return, however long the journeys which they make, to the place of their birth. The fact is everywhere verified to such an extent that it can be regarded as unquestionable. It results thence that the fish will be found again at the place where they were put into the water, unless untimely dams happen to impede their progress. It follows thence that the sacrifices which I recommend would not be made in vain—they would lead to direct results.

A fact of the same kind presents itself in my district. Since the enactment of the new fishery law the founding at Gand of a piscicultural association has been vaguely contemplated. Well, would you think it? The United States of America, who have agents everywhere, it is true, learning of this, have offered, through the great Commission of Fisheries of that country, to send us a fish that we have not and which is distinguished by peculiar merits. This fish has been selected for us* by the learned men of America, with special solicitude, because it is particularly suitable to the muddy waters of the Escaut. It would be of no use to us to receive trout or salmon; they would make a sorry figure in our rivers. Animated with broad and generous intentions, these men on the other side of the ocean, devoted to science and to humanity, have chosen what answers to our wants, and thus show us that for them there is no obstacle which can prevent the propagating of a good idea or the doing of a good action. You will read, one of these days, in the papers, gentlemen, that there have come to us from North America fishes for the basin of the Escaut.

These principles of solidarity, by enlarging the ideas, will bear important fruits, far beyond the limited point of which I am speaking.

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* It is proposed by the United States Fish Commissioner to send some catfish to Belgium this fall, as being well adapted to its muddy and sluggish waters. See correspondence in Bulletin for 1882, vol. 2, p. 153.—C. W. S.

26.—THE AMERICAN BLACK BASS.*

By MAX VON DEM BORNE.

1.—Its successful introduction in Germany.

From accounts which I had read, both in American and English publications, it appeared that the fish which in North America is known by the name of "black bass" possesses qualities which made it in the highest degree desirable for me to obtain some of these fish, and to make the attempt to raise them here. This desire became still stronger when the well-known fish-culturist, Mr. Fred. Mather, of New York, wrote me under date of the 31st October, 1881: "Why do you not introduce the black bass in your lakes, as is done in England? It is as gamy when on the hook as the salmon."

In March, 1882, therefore, I asked Mr. Mather, and Prof. Spencer F. Baird, of Washington, United States Commissioner of Fish and Fisheries, to aid me in this matter, and from both these gentlemen I received the kindest promises. Professor Baird wrote to Mr. E. G. Blackford, in New York, and Mr. Mather promised to have some of these fish caught in Greenwood Lake, about 50 miles from New York City, located partly in the State of New York and partly in the State of New Jersey. Mr. Mather did not deem it advisable, however, to attempt the conveyance of these fish during the warm season and without a person to accompany them during the voyage. In the beginning of August he caught a considerable number in Greenwood Lake, and he informed me, at the end of October, that he had 20 large fish and about 50 small ones ready for me. They were kept in the fish-tanks of Mr. E. G. Blackford, Fulton market, New York City, until the month of February last, when they were intrusted to the care of Mr. G. Eckardt, jr., of Lubbinchen, who was just returning to Germany after a stay of several years in the United States. To the care and management of that gentleman I owe it that all these fish arrived here alive and well. The voyage lasted from the 17th to the 27th of February, the fish being conveyed by the steamer Elbe, which had previously to this successfully carried a number of live fish to and from America. There were delivered to Mr. Eckardt, at New York, 7 black bass of the small-mouthed variety, 25 to 31 centimeters long; 45 of the large-mouthed variety, 7 to 13½ centimeters long; and 1 small *Perca fluviatilis*, which seems to differ somewhat from our perch. The large fish were distributed in 2 barrels, each having a capacity of about 500 liters, whilst the small ones were placed in 2 barrels of about 200 and 250 liters capacity. These barrels were not quite filled. The sea was rough, so that Mr. Eckardt had some trouble in taking

* "*Der Amerikanische Schwarz-Barsch.*" From Circular No. 2, 1883, of the Deutsche Fischerei-Verein, Berlin, April 30, 1883. Translated from the German by Herman Jacobson.

proper care of the fish. No special measures were taken, except to keep the water, by means of ice, at a temperature of 5 degrees Réaumur, and to remove the sediment by means of a pump; only a little fresh water was added. The attempt to feed the fish during the voyage did not prove successful. Upon arrival in Bremen the water was found to be as clear as at the departure from New York. At Geestemunde the fish were met by one of my assistants, who was kindly aided in landing them by Mr. F. Busse, wholesale dealer in fish. They were brought here in a large barrel, holding about 500 liters, the water being cooled by ice, and air being introduced in it. Because of some delay at Bremen the fish did not reach here till the morning of March 3. Upon their arrival they were all found to be lively and in good condition. Only one small black bass died after a while, and was sent to the Zoological Museum in Berlin, where Dr. F. Hilgendorf examined it, and identified it as *Grystes salmonoides* Lacépède.

2.—CHARACTER OF THE BLACK BASS.

All my information relative to the black bass I have obtained from the following sources: Forest and Stream, vol. 2, p. 120; vol. 4, pp. 342–357; vol. 8, pp. 260–359; vol. 9, p. 284; vol. 14, p. 349; and vol. 15, pp. 68, 366; Report of United States Commissioner of Fish and Fisheries for 1871–'72, p. 806; the same, for 1872–'73, pp. 392, 525; Robert R. Roosevelt's Superior Fishing, pp. 10, 11, 71, 75; Frank Forrester's Fish and Fishing of the United States, p. 195; Thaddeus Norris, The American Angler's Book, 1865, p. 103; Charles Hallock, The Fishing Tourist, 1873, p. 123; James A. Henshall, M. D., Book of the Black Bass, 1881—this is the most important source of information; Genio C. Scott, Fishing in American Waters, new edition, 1883, p. 280; and Transactions of the American Fish-Culturists' Association, 1882.

The original home of the black bass in America is the region of the Saint Lawrence and the Mississippi, whilst it is not found in the Middle States, New England, on the Atlantic coast, and in the rivers flowing into the Pacific. Henshall distinguishes two varieties: first, the large-mouthed black bass, *Micropterus salmonoides* Henshall, or *Grystes salmonoides* Lacépède; and, second, the small-mouthed black bass, *Micropterus dolomieu* Lacépède.

Both these varieties are usually found in the same water; they are lively, muscular, and voracious, bite very well, and afford excellent sport. When freshly caught they smell of musk. They are a great table delicacy, and are in this respect not excelled by any other fish. They are not very sensitive as regards the impurities introduced in the rivers from factories and cities, and are found as far south as the tropics, near the Gulf of Mexico, and as far north as the cold waters of the great fresh-water lakes on the boundary of Canada. They reach their greatest size in very spacious and deep waters and at a high temperature. In the north they attain a weight of four or five pounds, rarely six or

eight pounds weight; in the south, and in deep water, they attain a weight of twelve to fourteen pounds. In rivers, they like a strong current, rocky, stony, or gravelly bottom, and in lakes a gravelly bottom, logs of wood, roots of trees, plenty of aquatic plants, springs at the bottom, and very deep water; but they also flourish in still, shoal water, especially when it has a dense growth of algæs. The young fish live on very small animals, fish-eggs, insects, crawfish, frogs, mussels, &c.; in a few months they reach a length of five centimeters; in one year, ten; in two years, twenty to thirty, and a weight of one pound, and thereafter generally increase in weight one pound per year. The black bass spawn on rocky ledges, on gravelly or sandy bottom, at a depth in rivers of from half a meter to one meter; while in lakes they seek a place from one to two meters below the surface, on the edge of still greater depths. They make themselves a nest in the gravel, by removing the mud and sand with their tails and fins, thus creating a hole in the sand twice the length of their bodies; sometimes they line their nests, on muddy bottom, with small sticks and leaves; they also do this when there is gravelly bottom in the neighborhood. In the Southern States these fish spawn in March, in the North from the middle of May till the middle of July; the farther north the later they spawn. During this period they ascend the rivers till they find shallow water, or seek the shallow places near the shores of the lakes. The eggs adhere to surrounding objects, and are hatched in one to two weeks; the young fish remain in the nest from two to seven days, and both the eggs and the young fish are carefully guarded by the parents. During the cold winter season the fish become lethargic, cease to eat, and dig themselves holes in the mud, in which they hide, or retire to fissures in the rocks, or seek deep waters under moss and aquatic plants, where they sleep till the next spring.

3.—Transplanting black bass.

Both kinds of black bass when transplanted easily accustom themselves to the different conditions of life. They can easily be transported alive, and in ponds, lakes, and rivers increase rapidly and without any difficulty. Since 1820 the transplanting of these fish to waters where heretofore they were not found has been repeatedly attempted, and often with success. The transactions of the American Fish Cultural Association for 1882, page 19, contain the following interesting report by Mr. George Shephard Page:

"It can hardly be believed that, at the present time, any one can doubt the usefulness of stocking our waters with black bass. Not quite 60 years ago a few of this kind of fish were brought by rail from the Ohio River to the Potomac River, and a few years later a number were taken from this river to the Susquehanna. Not quite 15 years ago some black bass were transferred from the Susquehanna to the Delaware. And

now I simply refer you to the fish markets, not only of our large cities, but also of small and remote towns; everywhere we find that the black bass (by general consent considered as valuable for the table as for the sportsman) is more common than the pike, and cheaper than the white-fish (*Maräne*). The 39 fish which, in 1869, I placed in waters in Maine, have increased so rapidly that about one hundred lakes and ponds are full of them. Summer hotels and villas have been built on the shores of some of these lakes, and thousands of visitors are attracted almost exclusively by the large number of black bass. Many of our highest authorities in matters relating to fish think that is *the* fish of the future. One of our most recent and best works* is solely devoted to this fish. The manufacturers of fishing-tackle have noticed a constantly increasing demand for black-bass tackle. A large number of clubs have been formed for the sole purpose of catching bass. It is also very remarkable that, wherever the black bass has been introduced, the pike disappears rapidly, proving the truth of the old saying: 'The strongest holds the battle-field.'"

4.—Value of the black bass for German waters.

The black bass thrives best in large rivers having a strong current, deep water, and a rocky or gravelly bottom. It will, therefore, be specially suited for those parts of Germany in whose waters the barbel thrives. Excepting the migratory species the German fish-culturist has no domestic fish which is suitable for these waters, and whose increase he can regulate to any considerable extent. It is difficult to stock rivers, above impassible dams, with migratory fish, for these go to the sea when they are quite small, and are not able to return when they have grown large. It is my opinion, therefore, that the black bass is calculated to fill this gap. The same may possibly apply to the deep lakes, in which no Coregoni, saiblings, or lake trout thrive; but I consider it somewhat of a risk to place the black bass in waters where trout and saibling live.

An exceedingly valuable quality of the black bass is this, that it can be easily caught. It is frequently very difficult to catch carp and *maränen*, and the just objection is often made to the raising of these fish, that it is useless to introduce or to increase fish which cannot be caught.

It will be of great interest to our sportsmen to learn that those anglers who have become acquainted with the nature of the black bass esteem it just as highly as the salmon and the trout.

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*James H. Henshall: "Book of the Black Bass." Cincinnati, 1881.

Vol. III, No. 15. Washington, D. C. Sept. 3, 1883.

27.—PRELIMINARY NOTICE OF THE DEVELOPMENT AND BREEDING HABITS OF THE POTOMAC CATFISH, AMIURUS ALBIDUS (LESUEUR) GILL.

By JOHN A. RYDER.

A number of adult individuals of *Amiurus albidus* were brought from the Potomac River to the Armory building, at the instance of Lieut. W. C. Babcock, U. S. N., and Col. M. McDonald, and deposited in the large tank aquaria of that institution about the close of the shad fishing season of 1883. One pair of these have since bred or spawned in confinement, and thus afforded the writer the opportunity of observing and describing some of the more interesting phases of the development of this singular and interesting family of fishes. There has been hitherto little attention paid to the development of the *Nematognathi*, Siluroids or catfishes, probably from a lack of opportunity, and these notes may therefore prove of interest to naturalists. The literature of the subject is scanty; and besides a paper by Jeffries Wyman* on the development of *Aspredo lævis* and *Bagrus*, I know of no separate essays on the development of this group, except some scattered notices in Günther's Introduction to the Study of Fishes and in his article Ichthyology, ninth edition of the Encyclopædia Britannica, on the development of *Arius*; an egg of this genus in an advanced state of evolution is figured, from which it appears that this form is very similar in its embryological features to *Ælurichthys*, some ova of which are in my possession, measuring three-fourths of an inch in their longest and five-eighths of an inch in their shortest diameter. *Arius* and *Ælurichthys* are marine forms, and the males have the habit of carrying the ova in the hinder part of the oral cavity or branchial region until the young are hatched, as redescribed by W. Turner.† The marine species, however, have only a few ova at a time as compared with the *Amiuri*, common catfishes or horned pouts of the Eastern United States.

Prof. Theodore Gill has been kind enough to aid me in determining the species of which I here sketch the development, and he refers it to the form with the name given in the title of this notice. Its habits of spawning and care of the young are probably common to all of the species of the genus, and are quite remarkable, as will appear from the subjoined account.

On the morning of the 13th of July, a little after 10 o'clock a. m., we

* On some unusual modes of gestation. Am. Journ. Arts and Sciences, xxvii, 1859, pp. 5–13.

† A remarkable mode of gestation in an undescribed species of *Arius* (*A. Boakeii*) Journ. Anat. and Physiol., i, 1866, pp. 78–82.

noticed a mass of whitish eggs in one of our aquaria inhabited by three adult specimens of *Amiurus albidus*, two of which were unmistakably the parents of the brood, for the reason that they did not permit the third one to approach near the mass of eggs which one of them was watching vigilantly. One of the individuals remained constantly over the eggs, agitating the water over them with its anal, ventral, and pectoral fins. This one subsequently proved to be the male and not the female, as was at first supposed. The female, after the eggs were laid, seemed to take no further interest in them, the whole duty of renewing and forcing the water through the mass of adherent ova devolving upon the male, who was most assiduous in this duty until the young had escaped from the egg membranes. During all this time, or about a week, the male was never seen to abandon his post, nor did it seem that he much cared even afterwards to leave the scene where he had so faithfully labored to bring forth from the eggs the brood left in his charge by his apparently careless spouse. The male measured 15 inches in length, the female a fourth of an inch more.

The mass of ova deposited by the female in a corner and at one end of the slate bottom of the aquarium measured about 8 inches in length and nearly 4 inches in width, and was nowhere much over one-half to three-fourths of an inch in thickness. The ova were covered with an adhesive but not gelatinous outer envelope, so that they were adherent to the bottom of the aquarium and to each other where their spherical surfaces came in contact, and consequently had intervening spaces for the free passage of water, such as would be found in a submerged pile of shot or other spherical bodies. It was evident that the male was forcing fresh water through this mass by hovering over it and vibrating the anal, ventral, and pectoral fins rapidly. There were probably 2,000 ova in the whole mass, as nearly as could be estimated. All of those left in the care of the male came out, while about one-half of the mass which he had detached from the bottom of the aquarium on the third day, during some of his vigorous efforts at changing the water, were transferred to another aquarium, supplied with running water, and left to themselves. Those which were hatched by the artificial means just described did not come out as well as those under natural conditions. Nearly one-half failed to hatch, apparently because they were not agitated so as to force fresh water through amongst them and kept clean by the attentions of the male parent.

The eggs themselves measured about one-sixth of an inch in diameter a short time after oviposition, and after the large water space had been formed around the vitellus, between the surface of the latter and the egg membrane. The vitellus measured one-eighth of an inch in diameter. The germinal disk was formed at the upper pole of the vitellus immediately after oviposition, and gradually spread in the usual manner over the lower pole of the opaque granular vitelline globe. In the early part of the second day the body of the young fish was out-

lined, but the tail began to grow out before the embryo's body had embraced much more than one-fourth of the circumference of the vitellus. On the third day the tail of the embryo had acquired considerable length, and its free end was moved from side to side gracefully and rhythmically through the contents of the water-space.

The water-space from the first was filled with an immense number of free, refringent corpuscles, which made it difficult to make out the form of the embryo during the early stages. These corpuscles were not of the nature of blood-cells, and seemed to become less abundant towards the close of the period of development within the egg. Nothing of a similar character, as far as the writer is aware, has ever been encountered in the water-space of any other Teleostean egg. So abundant are these corpuscles at first, coupled with the opacity of the vitellus and the peculiar whiteness of the germinal matter, that even an experienced observer would be led to suppose at a first glance that all of the eggs were bad, having the "rice-grain" appearance of blasted shad eggs.

On the third day the vascular system begins to develop and the heart to grow forward under the head, down over the anterior end of the yelk. A pair of vascular arches (cuvierian ducts) are soon formed, just behind the rudiments of the pectorals, which grow outward and split up into vitelline capillaries and eventually join a median vitelline vessel which empties into the venous end of the heart. The mouth is widely open on the third day, and the branchial clefts are developed with a free circulation through the arches. The caudal part of the aorta and caudal vein is also developed at that time, and the intersegmental vessels are developed a little later, with loops running out into the mesoblast of the median natatory fold.

The eyes of the embryos were unusually small for young fishes, and reminded one during the early stages of the eyes of Ganoids and young Amphibians. The choriod fissure was prolonged obliquely far forwards. The eyes were pigmented on the fifth day.

The air-bladder became perceptible on the tenth day, far forwards, and as a dorsal outgrowth of the intestine, a little above and behind the level of the insertion of the pectoral fins, and as it grew more capacious the young fish commenced to swim higher in the aquarium. When first hatched, on the sixth to the eighth day, the young exhibited a tendency to bank up or school together like young salmon. They also, like young salmon, tended to face or swim against the currents in the aquarium, a habit common, in fact, to most young fishes recently hatched.

The development of the fins was somewhat similar in general character to that usually observed. On the second day the medial natatory fold began to grow out on the dorsal and ventral side and the end of the tail, but up to the fifth day no clearly-marked differentiation of any of the unpaired fins had occurred. The first of the paired fins to appear were the pectorals, which began to show themselves on either side of the body on the third day, a little way behind the ear, as a pair of low lon-

gitudinal folds. The first of the unpaired fins to be developed was the anterior dorsal, which was first marked off from the rest of the natatory fold on the fifth day by a slight emargination near the anterior end of the latter. Coincidently with the development of the first dorsal the first rays of the caudal began to develop on the fifth day, just below the upturned caudal end of the notochord, which terminated near the dorsal border of the tail, but no distinct embryonic caudal lobe was ever developed such as that described by A. Agassiz in the young of *Pleuronectes*. The development of the tail was in fact very similar to that of the salmon, even to the presence of a similar vascular plexus and a small but perceptible venous sinus. On the seventh day the mesoblast was perceptible in the anterior dorsal and in the anal, and the rays in these two fins had begun to develop. On the seventh day the caudal had assumed a clearly-marked fan shape. On the eighth day the anal was more apparent as a prominent expansion of a part of the ventral portion of the natatory fold, and its rays had become more distinctly visible. By the tenth day the rays in the first dorsal and the anal were distinctly developed, and both fins were sharply marked off from the rest of the fins developed from the natatory fold by deep angular emarginations. On the tenth day the adipose dorsal appeared as a separate lobe, which became progressively more distinctly developed. On the eighth day the ventrals budded out as a pair of folds above the hinder end of the yelk sack, at the lower edge of the body, just a little way in front of the vent. On the tenth day the caudal became distinctly lobed and posteriorly emarginated, the upper lobe being the longest, and on the eleventh day all of its rays were defined. By the thirteenth day the yelk had been absorbed, and the young fish were nearly ready to feed. By this time, too, the rays had appeared in the ventrals. By the fourteenth day the first hard spine of the anterior dorsal was developed, and the anterior spiny rays of the pectorals had been formed with two retrorse hooks on their hinder margins. By this time the young had practically passed through their larval condition, and began to bear a striking similarity to the adults, having by this time also become quite dark on the upper side of the body from the development of pigment cells in the skin.

On the fifteenth day after oviposition it was found that they would feed. While debating what should be provided for them, Mr. J. E. Brown threw some pieces of fresh liver into the aquarium, which they devoured with avidity. It was now evident that they were provided with teeth, as they would pull and tug at the fragments of liver with the most dogged perseverance and apparent ferocity. This experiment showed that the right kind of food had been supplied, and as they have up to this time (August 1) been fed upon nothing else, without our losing a single one of the brood, nothing more seems to be required with which to feed them.

It is worthy of note that when pieces of liver were thrown into the aquarium the parent fishes would apparently often swallow them, with numbers of young ones eating at and hanging to the fragments. I was soon agreeably surprised to find that the parent fishes seemed to swallow only the meat, and that they invariably ejected the young fish from the mouth quite uninjured, the parent fish seeming to be able to discriminate, instinctively, before deglutition occurred, between what was its proper food and what were its own young. As soon as the young began to feed they commenced to disperse through the water and to all parts of the aquarium, and to manifest less desire to congregate in schools near the male, who also abated his habit of fanning the young with his fins, as was his wont during the early phases of development.

The most interesting feature of the developmental evolution of the young catfishes is the early appearance of the barbels. The first pair which is visible is the maxillary at the angles of the mouth of the embryo. This pair of barbels grow out at either angle of the mouth, on the third day, as a pair of flat lobes, continuous anteriorly with the upper and anterior border of the mouth. By the fifth day the maxillary barbel becomes much prolonged and cylindrical, while the two pairs of chin barbels appear at the same time a little behind the outer margin of the lower jaw as two pairs of low fleshy papillæ. By the seventh day these, also, have grown considerably in length and become cylindrical. On the same day the nasal pair of barbels have been formed as papilliform outgrowths at the anterior margin of the posterior nostrils, the anterior and posterior nostrils being already separated by a pretty wide bridge of tissue. The early separation of the anterior and posterior nostrils by a bridge of tissue in the embryo catfish is a striking instance of the acceleration or precocious development of this structure, which is not usually formed so early. By the seventeenth day all of the barbels have acquired very nearly the same length in proportion to other parts of the body, as may be noted in those of the adults, but they are nearly transparent and appear to be thickly studded superficially with specialized end-organs, which are probably tactile in function. Their order of development is as follows: First the maxillary, then the outer, then the inner chin barbels, and lastly the nasal barbels are formed. The early and peculiar development of these cephalic appendages already distinguishes the embryos catfish on the third day from the embryos of all other forms of Teleosts.

The intestine is not prolonged far backwards beyond the posterior end of the yelk sack. On the thirteenth day the greenish secretion of the liver can be seen in its cavity. Nothing was observed of the development of the liver, but it is probable that a portion of the blood from the caudal vein passes through it and then passes through a vitelline network of vessels back to the heart.

Behind the vent, a distinct urinary duct could be seen by the sixth day, and by the tenth day an allantois or urinary vesicle was developed

in the usual position behind the anal end of the intestine. Transparent views showed that the segmental ducts were tortuous at their anterior extremities. Nothing was learned of the character of the pronephros, one of the features of development which may very properly be studied when we have once prepared sections from the material which has been preserved for the purpose.

On the 30th of June, or when the young were seventeen days old, it was determined to make an examination of the internal organs of both parents, which was done in the presence of Professor Gill, to learn which one of the parent fishes it was that had acted as nurse. Fortunately there was considerable difference between the two in color; the female had also lost a part of one maxillary barbel, so that it was easy to distinguish them apart. The darkest specimen, with the broadest head, we found was the male, and, as already stated, had acted as the nurse. Upon cutting him open and removing a portion of the milt or testes, they were found as a lobulated paired organ on either side of the mesentery, depending from the dorsal wall of the abdomen. The lobes of the testes were digitate. Upon compressing fragments of the testes under the microscope, active spermatozoa were pressed out. The spent roe or ovary of the female was a paired organ, the right and left sacs of which were joined together posteriorly. The ovarian lobes or leaflets were disposed transversely in the sacs.

The foregoing account of the development and breeding habits of *Amiurus albidus* is preliminary to a fuller one, accompanied by illustrations, taken from hardened and preserved material in the hands of the writer.

CENTRAL STATION, UNITED STATES FISH COMMISSION,
Washington, August 1, 1883.

28.—ON RAINBOW TROUT REARED FROM EGGS BROUGHT FROM CALIFORNIA.

By ROLAND REDMOND.

[From a letter to Prof. S. F. Baird.]

There are some Rainbow trout at the South Side Club, raised from a few eggs you sent them three years since, which show an extraordinary growth for their age, one being 22 inches long and weighing fully three pounds. They have begun to show a change in their spawning season, the eggs having become ripe about Christmas time.

Can you kindly spare us some more eggs this spring? The association is anxious to stock one of its ponds with this fish.

105 FRANKLIN STREET, NEW YORK, *March* 28, 1883.

29.—SWEDEN AT THE GREAT INTERNATIONAL FISHERY EXPOSITION AT LONDON, 1883.*

By AXEL VILHELM LJUNGMAN,

[Member of the Swedish Parliament for the districts of Oroust and Tjörn.]

As a pamphlet has been distributed in the Swedish Parliament, relative to the resolution passed by the lower house February 28, last, to grant only 25,000 crowns ($6,700) for meeting the expenses connected with Sweden's representation at the International Fishery Exposition, to be held during this year in London, and as this pamphlet is principally directed against me, I deem it proper to say a few words in reply.

The pamphlet, which bears the signature of Prof. F. A. Smitt, begins with a testimony to the enormous importance of fishery expositions for the advancement of the fishing industries; and this is, strange enough, followed by a comparison between the poor condition of the Swedish fisheries and those of foreign countries. This second part of the pamphlet in question, which is, moreover, accompanied by statistics intended to prove the author's assertion, is, however, utterly at variance with the first part, where the beneficial influence of expositions is spoken of with the highest praise; for if fishery expositions were really so beneficial to the fishing industries, the Swedish fisheries ought to rank very high, considering that Sweden has taken part in these expositions in the most energetic manner. I shall, further on, show that our too energetic participation in the fishery expositione has been one of the principal causes why the development of our fishing industries has not kept step with that of foreign countries, but has remained far behind them. I therefore take the liberty to repeat here what I said in the lower house, that, if fishery expositions are to prove a real benefit, they should be managed upon an entirely different plan from that followed at our Swedish expositions, and especially at the Berlin Exposition of 1880. The prejudices of the Norwegians, in this respect, are very significant.

Professor Smitt speaks of the great importance of expositions for fish-culture. With regard to this subject we will quote the following from the writings of a prominent author, who has made fish-culture a specialty.† He says: "Although the culture of salmon, salmonoids and various kinds of *Coregonus* has been carried on, on a large scale, in several countries of Europe for thirty years, we have no positive proof from any European country that this culture has, to any considerable extent, increased the quantity of fish in the open waters, * * *

* *Sveriges deltagande i internationela fiskeriutställningen i London,* 1883. *Germäle.* Stockholm, 1883. Translated from the Swedish by HERMAN JACOBSON.

† A. J. Malmgren: "*Utlåtande angående lämpligheten af artificiel fiskodlings införande Finland.*" Helsingfors, 1883.

or has been followed by financial results in proportion to the amount of money expended, or by results of general importance. It is absolutely certain, that in those very countries which have for the longest time and most energetically labored to increase the quantity of fish in the open waters, by the artificial production of young fish, confidence in the economical importance of artificial fish-culture has been thoroughly shaken. * * * In fact, it must be said that in Europe fish-culture has left nothing but disappointed hopes, and in many cases has caused serious financial losses." The importance of fish-culture is, therefore, far from having been proved; and the fishery expositions have not furnished a solution of the greatest difficulty, viz, the care of the young fry. All that fish-culture, an industry the value of which is openly questioned, can gain from an exposition, is a comparison of the various apparatuses. But as regards the manner in which these apparatuses are used, and in fact in all other respects, the necessary knowledge must be obtained in the place where the fish are raised, where fisheries are carried on, and where fish are prepared. As regards the care to be taken of fish, the fisheries, and the preparation of fish, but little knowledge can be gained at an exposition, as Professor Smitt himself seems to think. If this had not been his view of the matter, he ought to have produced more proof, especially with regard to the Berlin Exposition, of the benefits of such expositions, than the introduction of "Japanese traps" in Södermanland. All this only goes to prove the correctness of my assertion, that the Norwegians act wisely in only granting a small appropriation for the London Exposition, whilst care is taken that many persons who have made fisheries a specialty are enabled to travel to foreign countries to gather knowledge, the results of their observations, as well as those of the commissioners sent to the exposition, being published and spread broadcast over the land. It should not be forgotten that my remarks in the lower house were aimed at the way in which fishery expositions have hitherto been managed by our commissioners, and at the condemnable habit of spending more than necessary for this purpose.

During the long controversy regarding the Bohuslän herring fisheries, I have repeatedly maintained, in opposition to Professor Smitt, that the first condition for flourishing fisheries is a well-organized fish trade and a regular and rapid sale of the fish. Particularly, as regards the herring fisheries, it will be evident, even to a superficial observer, that if herring can be prepared as a valuable article of commerce, and in such a manner as to keep a long time, and bear transportation to distant countries, the market for them will extend, thus enabling the fishermen to get better pay for their fish; and the fisheries in general will be benefited thereby, for a high price of fish encourages the fishermen, and enables them to get better and more expensive apparatus, and to introduce new and improved methods. With this view I have always urged that it was of primary importance that the Government should

facilitate the sale of fish, if necessary, by introducing improved methods of preparation; but my words were in vain, principally owing to Professor Smith's influence; and on the Bohuslän coast people had to wait till the year 1882 for measures introducing the salting of herrings according to the Scotch method, simply because the money needed for this purpose was spent on the Berlin Exposition and on Professor Smitt's resultless experiments with floating nets. Professor Smitt does not seem to recognize the importance of ready sales for the fishing industries, and he, of course, prescribes expositions as the best remedy for our, undoubtedly, unsatisfactory sales. If expositions, however, were beneficial in this respect, it is more than strange that our sales of fish are far from satisfactory, in spite of the lively interest taken by Sweden in all foreign fishery expositions, and that Professor Smitt can show no convincing proof that the great Berlin Exposition of 1880 has caused any increase in our exportation of fresh salmon, herring, &c. The exportation of these kinds of fish went on even when there were no expositions, and has not been noticeably increased by them. Successful efforts to increase the sale of fish made during an exposition need moreover not necessarily owe this success to the expositions. Such efforts should be made at all times, and, as far as our sales in England are concerned, the sooner they are made the better, as good fresh fish may always count on ready buyers in the great Billingsgate fish-market. Thus an arrangement has recently been made for selling the fish from the Bohuslän bank-fisheries fresh from the sea to steamboats; and this arrangement was made independent of any exposition. The same might also be done in other cases. The "hints as to improving their condition," which, although not heretofore made known, are said to have been given to our fish-dealers by the Berlin Exposition, they could easily have done without. More vigorous public measures and a more thorough knowledge of the fisheries, and not these mystic "hints," are what are needed for furthering our fishing industries. The facts produced by Professor Smitt only show that some insignificant results may be obtained by comparatively slight efforts during a fishery exposition. How much greater results could, therefore, be obtained by steady efforts in the same direction, made with due circumspection and a thorough knowledge of the subject? That country of Europe whose fisheries are at the present time more important than those of any other country, Great Britain, which has raised its fishing industries to a very high condition of excellence, has brought about this result by entirely different means than fishery expositions.

Professor Smitt's attempt to find a reason for the present condition of our fish trade, by saying that the Berlin Exposition has injured the exportation of our preserved fish, is only another proof of his way of deceiving the public. Germany's new customs legislation has, at the same time, not injured the exportation from other countries of preserved and smoked fish.

Since the Scotch method of salting herrings has, in spite of violent opposition and in spite of expositions, been introduced on the coast of Bohuslän the price for herrings salted according to this method rose immediately. From the southern part of Sweden nothing but fresh herring are exported, whilst Scotland exports large quantities of smoked herring and gets a higher price for this article. By introducing better methods of salting and smoking and by preparing the small fish as sardines, the income from our large herring and small herring fisheries could doubtless be doubled; but, as will be shown below, expositions have positively hindered the introduction of such improvements.

Among the most remarkable and most incorrect statements in Professor Smitt's pamphlet is the following relative to the Edinburgh Exposition, which also aimed at laying down the law in matters pertaining to the fisheries: "The knowledge gained by the exposition has been productive of great life and activity, especially on the coast of Bohuslän. Salters, packers, and smokers have been brought over from Scotland, large and improved cooper shops have been set up, and many new salteries, oil refineries, and guano factories have been established." All this sounds very well; it is only a pity that the above-mentioned exposition has had nothing whatever to do with these improvements. The greater life and activity has simply been caused by the greater abundance of fish, particularly during the winter of 1881–'82; and the measures for introducing improved methods of preparing fish had been taken prior to said exposition. Of the oil refineries, one was in full blast long before the exposition, and the other had been planned before the exposition was opened; and the third and smallest has not been established in consequence of any knowledge gained in Scotland, where this industry is not carried on. As regards the salting of herring, there had been, long before the Edinburgh Exposition, a strong sentiment in favor of the Scotch method, principally fostered by the press and by descriptions of this method published in pamphlet form and distributed on the coast as early as January, 1878. This sentiment also determined one of the largest herring firms on the coast of Bohuslän to introduce the Scotch method of salting *long before* the Edinburgh Exposition, and induced the great cooper establishment at Uddevalla to adopt the shape and size of the Scotch herring barrel. Herring-barrel factories do not exist in Scotland, where all barrels are hand-made. The fact that three fishermen were, at the expense of an association, sent to Scotland to attend the exposition, has not benefited our fishing industries, as the information gained by them was very little compared with what they would have gained by a visit to the east coast of Scotland during the period when herring are caught and salted. The resolution passed by the association referred to, to introduce Scotch coopers and salters was, doubtless, owing to the idea that something might be learned from a country where the herring industry had reached a very high degree of perfection, and not because knowledge had been gained at an exposition.

The true value of fishery expositions to the Bohuslän herring salteries may be learned from the fact that soon after the Berlin Exposition, which had decreed gold medals to the Bohuslän salteries for the excellence of their productions, a notice was inserted in the Bohuslän papers, by the most prominent Gottenburg fish-dealers, that, owing to the inferior character of the Bohuslän salt herring, they would no longer deal in this article. Truly a brilliant result of the exposition prizes!

Whenever the introduction into Sweden of improved methods of preparing fish is urged, it is met with indifference or opposition from those of our salters who have gained prizes at expositions, who think that they represent the very perfection of this industry and consider themselves the only models worthy of imitation. These prizes which, at the expositions, are generally given in proportion to the space occupied by a country, and in the distribution of which personal motives are frequently all-powerful, and which, therefore, are by no means absolute proofs of the excellence of the articles which have gained prizes, have, together with newspaper articles highly laudatory of the productions of their own country, contributed not a little towards spreading erroneous ideas among the public and also towards throwing difficulties in the way of improvements, which will only be introduced when the opinion has gained ground that they are absolutly needed. The expositions have also produced a number of far-famed exposition heroes, who live on the praise bestowed on them by these expositions, assert an undue influence over the industries, and have even gone so far as to obtain prizes for their friends and favorites.

The circumstance that expositions are in such high favor with the general public is, no doubt, owing to the manner in which they have flattered the vanity, not only of some exhibitors, but also of entire nations. As the participation in an exposition does not involve any expense to the exhibitors, and as every one, of course, hopes to gain a prize, it is not astonishing that the applications are so numerous, especially as no effort is spared to go beyond all bounds in the preparations for such expositions. These expositions have very much the same attraction to manufacturers as lotteries, where the government, so to speak, furnishes the tickets and the exhibitor only loans his apparatus or the product of his industry for exhibition. Many a person feels his vanity tickled by the knowledge that he has taken part in a world's exposition, and that his name has figured in the catalogue, more especially as these honors may be gained without any expense.

Professor Smitt says that Sweden, in order to remove the disproportion between her importation and exportation of fishery products, should, "in the first place, aim at increasing the value of her deep-sea fisheries and of her salmon fisheries." Strange to say, the professor seems to have abandoned all hope of ever improving the Baltic and Kattegat fisheries. To improve these two important fisheries, which are full of promise, experience has taught us that far different and more

vigorous measures than expositions are required. As regards the much talked of Bohuslän herring fisheries, the use of floating nets in these fisheries is nothing new. During the eighteenth century this implement was employed far more extensively than now, and with the same results. Even in our day it has been repeatedly employed on the coast of Bohuslän, even before Professor Smitt came in the winter of 1880–'81, and, aided by a Government subsidy, made a great ado about it in the papers, in spite of which, owing to very plain causes, matters remained pretty much as they had been before. Four years ago I stated, relative to the proposition, made too soon, then, to introduce floating nets for the herring fisheries on the Bohuslän coast, the following, which ought to be taken to heart by those concerned: "To introduce with advantage a new implement or a new method of fishing requires that its application will pay. Thus futile attempts were made to introduce floating nets for the mackerel fisheries on the coast of Bohuslän as long as the price of mackerel was so low that the larger number of fish caught with the floating nets was not sufficient to pay for the getting and keeping of these expensive implements. When the price of mackerel rose, the floating nets were quickly introduced; but if the price of mackerel should again decrease, the floating nets would again disappear, and the common and inexpensive nets would soon again be in general use." If the Bohuslän people are to use floating nets on a large scale for the herring fisheries, it is of course necessary for them to be able to count on catching every year a sufficiently large quantity of herring before the fisheries commence near the coast to make it worth their while to get these expensive implements. That this applies to a small quantity of fish which, when brought into the Gottenburg market, are, owing to their small number, sold by the score or by the piece, does by no means prove that this will also apply to large fisheries; for as soon as very large quantities of fish are brought into the market prices decline. Whether the herring fisheries can be profitably carried on with floating nets will, in Bohuslän, as in Scotland, depend on the price which the salters can pay for the herrings. In order to form some idea as to the prospects of such fisheries, one ought to know the average catch per boat in tons. To judge of the prospects of a certain method of fishing by the prices which are paid when only small quantities of herring are brought into the market, would be just as erroneous as to judge of the prospects of the potato harvest from the prices which early in the season are paid in the city markets for new potatoes. It should be borne in mind that both herring and potatoes are the poor man's food, and that the large quantity of each of these articles makes it necessary for them to be sold cheap. It is highly characteristic of Professor Smitt's method of proving his assertions that he does not venture to state the quantity of herring caught by each boat, or by the one which caught most. All he gives is the excessively high price paid for herring when they are scarce. If the herring fisheries on the

coast of Bohuslän are to be carried on with floating nets, care should be taken to bring about the conditions on which the success of such fisheries will absolutely depend; and, thanks to Professor Smitt's uncalled-for interference with the Bohuslän sea-fisheries, this is either delayed or hindered. Owing to the Berlin Exposition and utterly resultless experiments with floating nets, the introduction of improved methods of preparing herrings, which was essential for the future success of the Bohuslän herring industries, had to be deferred. We have also to thank the professor that special laws for these industries, by which in time they might have been properly regulated, are still among the things to be desired.

As the new settler first cultivates the most promising part of his ground, and afterwards, when he is better prepared, the poor ground, so also does the fisherman in choosing the method for a new fishery. The easy, cheap, and promising modes of fishing are taken in hand first, and the less promising or more expensive methods are only applied in proportion as the fisheries begin to pay better. Less profitable apparatus must also, when the fisheries again become more productive, give way before profitable apparatus, which principally determines the prices during the entire fisheries. It thus happened in the eighteenth century in Bohuslän, when the fishermen who came to our coast from Schoner had soon to exchange their nets for those in general use on the Bohuslän coast, as otherwise their fisheries would hardly have paid them for their trouble. As Professor Smitt has abandoned his former assertion relative to the unsuitableness for salting of the herring caught according to the present method, and has voluntarily declared that the Bohuslän herrings, as caught at present, may "by an improved method of preparing reach such a degree of excellence as to fetch the same price which is now paid for Scotch herring." It seems evident that there is little prospect that herring fisheries, carried on with floating nets on a large scale, will, in the near future, be able to compete with the present method, which insures a much larger catch. As it has been stated that the most successful Bohuslän boat, which employed a floating net, had been able to sell small quantities of herring by the score, to the amount of 1,880 crowns [$503.84], we will, for comparison's sake, here state the fact that last winter the Marstrand fishermen sold their rich catch from stationary nets by the boat-load or by the barrel, and realized about 23,000 crowns [$6,164]. (A common Bohuslän net, with boats and everything belonging to it, costs from 2,600 to 3,000 crowns [$696.80 to $804], according to size, whilst the floating-net boat, according to the Government standard, cost, as Professor Smitt tells us, 7,350 crowns [$1,969.80].) Even richer catches than those mentioned above are reported as having been made with the American purse-seine (*snörpvad*), an apparatus which can be used both in the coast waters and farther out at sea, and the practical character of which has made it impossible to introduce floating nets in America. But no improvements in the methods of fish-

ing or fishing apparatus find favor in the sight of Professor Smitt, who is a lover of antiquities.

That Professor Smitt now, in contradiction to his assertion made in 1878, feels compelled to agree with me in my views regarding the spawning-season of the Bohuslän sea herring, which I propounded as early as 1874, is hereby gratefully acknowledged, although the professor is not able to increase our knowledge as regards either place or time of spawning by any facts gained by his own personal observations.

With regard to the exhibition of scientific collections at a fishery exposition, it must be said that they are of some use, as they will throw some light on the entire fishing industries of a country. This does not, however, apply to portions of the Swedish exhibit, such as the collection made during the voyage of the Vega, and other collections, which have not the remotest connection with our fisheries, but which require an increase of space and an increased expense. When we read in the papers that it is proposed to exhibit "fishing tschukts" and "five skeletons of whales, of kinds which are so rare that they are not even found in the British Museum," &c., this cannot fail to awaken some disapproval, mixed with distrust, as to the object of our representation at the exposition, and regarding the manner in which the directors of our museums fulfill their duties.

The sum appropriated by the lower house of the Swedish Parliament is, considering the extent of our fisheries, the population of our country, and our financial resources, larger, comparatively, than that which, according to Professor Smitt, has been appropriated by the United States of America for the same purpose.

With regard to the appropriation for the exposition, Professor Smitt has evidently not been able to find sufficient reason why Sweden's small fisheries require so much larger an appropriation than Norway's extensive fisheries. When he objects to my not counting with the sums appropriated by Sweden for the fisheries the extra appropriations, the ones granted by the upper house and by the "economical society," and, moreover, lays special stress on the circumstance that among these extra appropriations is the sum granted by the herring industries of Bohuslän, he must certainly know very well that even counting in these amounts does not materially change the disproportion between the amounts granted for the fisheries direct and those appropriated for the representation of Sweden at the fishery exposition, a disproportion which seems all the greater when we compare our circumstances with those of Norway. It should also be remembered that among the sums appropriated for the fisheries in Norway for 1882–'83 I have not counted the extra appropriation of 12,000 crowns [$3,216], which was asked to aid fishermen and men engaged in the fishing industries to travel to foreign countries, and that I have not given the maximum amount of the Norwegian appropriation, as given in the *Norsk Fiskeritidende*. As regards the small grants which I have enjoyed for nine years for carrying on my

investigations of the herring fisheries, I must candidly state that they have not been large enough to cover my expenses, but that I have been obliged every year to put my hand in my own pocket and make considerable sacrifices. Why does not Professor Smitt, who is backed by the Government and its powerful aid, count my expenses among the sums appropriated? Why does he hint, in utter disregard of actual facts, that I had every year enjoyed "a very considerable subsidy" whilst he takes good care not to mention the fact that since the summer of 1880 he has, annually, enjoyed a much larger Government subsidy for his work in connection with the fisheries? Professor Smitt's disregard of facts certainly does not tend to further his cause.

STOCKHOLM, *March* 24, 1883.

30.—THE INSTRUCTION OF NAVAL MIDSHIPMEN IN TAXIDERMY ICHTHYOLOGY, ETC., AT THE UNITED STATES NATIONAL MUSEUM AND ON BOARD THE STEAMERS OF THE UNITED STATES FISH COMMISSION.

By Prof. SPENCER F. BAIRD.

In the American naval service the cadets start with four years' study in the Naval Academy at Annapolis. They are then sent to sea for two years, and do not obtain the rank of midshipman until they have passed an examination at the end of this period, or of six years after their entrance. They are then sent to sea again, or placed on waiting orders.

About a year ago the Navy Department made inquiry of the Smithsonian Institution as to its willingness to receive six recently appointed midshipmen, and assign them to some duty in the Institution or National Museum that would enable them to take advantage of any opportunities they might have for natural history research during their future cruises, with the understanding that they were to be treated in every way as regular employés of the Institution and required to do regular work.

The proposition was responded to favorably, and the six persons were assigned respectively to curators of ichthyology, marine invertebrates, ethnology, paleontology, geology, and mineralogy. The experiment somewhat unexpectedly proved to be a very great success. The young gentlemen devoted themselves earnestly to their work and became proficient in it.

A course of special instruction was given in regard to the taxidermy of mammals and birds, which all the midshipmen attended with great diligence, becoming quite expert in the preparation of skeletons and in mounting excellent skins of mammals and birds.

The two assigned to ichthyology and marine invertebrates were detailed for service on board the Fish Commission steamer Fish Hawk, where they had ample opportunity of becoming familiar with collecting at sea, as also with the methods and appliances of deep-sea dredging,

temperature observations, &c., all, of course, directly in the line of their future vocation.

The other four accompanied one or the other of Professor Powell's parties into the far West, and have had every opportunity for field work.

The results of this experiment have been so satisfactory that it is proposed to detail six more midshipmen during the present month, the first six to continue another year, making the entire course one of two years.

The selections for this detail are made by the Navy Department, after conference with the Superintendent of the Naval Academy, from among those who, while pursuing their educational course, have shown most interest in scientific matters.

The measure is extremely popular among the younger officers, although of course it is decried by others, who consider it an innovation in the established routine.

One special object of the experiment is to have as a part of the regular force of the Navy, officers competent to do the scientific work for which it has generally been necessary to employ civilians, as also on any cruise to be able to utilize to some extent at least the opportunities of research which constantly present themselves to the inquirer.

WASHINGTON, D. C., *October* 7, 1882.

31.—EXPORT OF FISH OIL FROM NORWAY, 1878-'82.

By FREDRIK M. WÅLLEM.

[Extract from letter to Prof. S. F. Baird.]

Official returns regarding the export from Norway of fish oil are just issued. They show the export for December, 1882, to have been 4,400 hectoliters fish oil, and for the past five years as follows:

Years.	Hectoliters.	Gallons.
1882	100, 600	2, 657, 550
1881	128, 000	3, 381, 376
1880	169, 000	4, 464, 473
1879	143, 000	3, 777, 631
1878	137, 000	3, 619, 129
Average	135, 520	3, 580, 032

The Lofoten cod fishing has commenced, but the fish are not fat, and the liver will not give so much oil as an average year, still it is too early to tell how much the oil product shall be.

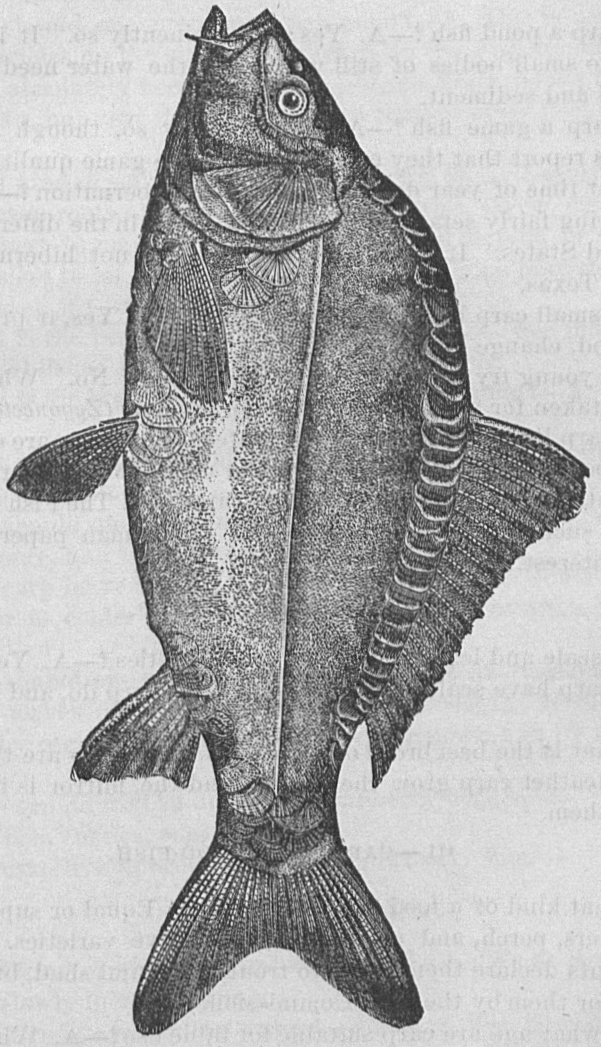
BERGEN, NORWAY, *February* 16, 1883.

Vol. III, No. 16. Washington, D. C. Sept. 3, 1883.

32.—ANSWERS TO 118 QUESTIONS RELATIVE TO GERMAN CARP.

By CHAS. W. SMILEY.

During the past fifteen months the correspondence of the United States Fish Commission has included a great number of letters of inquiry con-



Leather carp (*Cyprinus carpio.*)

cerning the German carp. The 118 questions here considered have all been taken from letters received during that period, and most of the

questions have been asked over and over again. As they cover considerable of the practical information required, it is hoped that the answers here given will be valuable. Fuller information upon many of the points may be obtained from published documents of the Commission. I am indebted to Col. M. McDonald for assistance in preparing some of the answers.

The questions and replies are classified under sixteen heads, so that one can easily find any information he is seeking.

I.—GENERAL INQUIRIES.

1. Is carp a pond fish?—A. Yes; pre-eminently so. It is especially adapted to small bodies of still water, and the water need not be free from mud and sediment.

2. Is carp a game fish?—A. Not properly so, though some correspondents report that they consider it to have game qualities.

3. What time of year do carp appear after hibernation?—A. As soon as the spring fairly sets in, which differs much in the different parts of the United States. It is probable the carp will not hibernate at all in Southern Texas.

4. Can small carp be wintered in a cellar?—A. Yes, if provided with proper food, change of water, &c.

5. Will young fry swim on top of water?—A. No. What is sometimes mistaken for young carp is the top minnow (*Zygonectes*).

6. Do carp live a long time out of water?—A. They are quite hardy, and can be kept alive out of water, if in moss, twenty-four hours.

7. What work is authority on carp culture?—A. The Fish Commission publishes such articles and translations of German papers as are of general interest.

II.—VARIETIES OF CARP.

8. Are scale and leather carp different varieties?—A. Yes.

9. Do carp have scales all over?—A. Scale carp do, and leather carp do not.

10. What is the best breed of carp?—A. Scale carp are the most prolific, the leather carp grow the fastest, and the mirror is intermediate between them.

III.—CARP AS A FOOD-FISH.

11. What kind of a food-fish is carp?—A. Equal or superior to catfish, suckers, perch, and all our common native varieties. Many correspondents declare them equal to trout, bass, and shad, but this is not claimed for them by the Fish Commission.

12. At what age are carp suitable for table use?—A. When small the bones are troublesome, but the flavor is the same. When they weigh 4 pounds or more the bones can be easily removed.

13. What season of the year are carp fit for the table?—A. From October to May. During and for several months after spawning the flesh is soft. No fish is in good condition to eat for some time after its spawning time.

14. Do carp have many bones?—A. What fish does not? The flesh flakes off, however, very nicely from large carp.

IV.—PONDS AND TANKS.

15. How large a pond is necessary for carp?—A. Larger the better, but a small one of a few yards square will answer for a few fish.

16. How should one prepare a carp pond?—A. This is answered at length in articles on the subject published by the Fish Commission.

17. Is it absolutely necessary to be able to drain ponds to the bottom?—A. No, but very desirable so as to remove other fish, enemies of carp, &c.

18. What kind of soil is best adapted for carp?—A. Loamy or muddy soil. The carp roots about in it for grubs, worms, larvæ, &c.

19. Is it best to make the border of the pond sloping or vertical?—A. It is easiest to let it slope, and there is usually no particular advantage in making it vertical.

20. What is the best way to construct a dam?—A. See plans and descriptions published by the Fish Commission.

21. What is the best material for constructing a dam?—A. Stone and earth.

22. What is the best plan of an escape way?—A. See plans of ponds by Fish Commission.

23. How should one prevent fish escaping from the pond?—A. Make the dam secure, and put wire cloth over the outlet.

24. Will carp leave a pond when it overflows?—A. Not if the superfluous water is colder than the bottom water, as is often the case in floods.

25. How should one prevent carp leaving pond at overflow?—A. Arrange wire sieves for the overflow to pass through. Avoid overflow if possible by regulating the amount of water flowing in by means of a waste weir.

26. Will carp do well in ditches of cranberry bogs?—A. Yes; if free from other fish, turtles, snakes, &c.

27. Will carp live in ornamental fish tank?—A. Yes.

V.—WATER FOR CARP.

28. What kind of water is adapted to carp?—A. Warm water. They grow very slowly in cold water.

29. Will carp live in shallow water?—A. Yes; even if so shallow that their backs sometimes protrude from the water, but there should be one deep spot for them to go to in winter.

30. Is shallow or deep water best for carp?—A. Shallow water is usually warmer, and hence better for carp. Better have both, if possible.

31. What temperature of water is best adapted to carp?—A. High temperatures. They can live in cold water, but do not grow much. They thrive in warm water.

32. Is slow-running water suitable for carp?—A. They are sluggish and care nothing about running water.

33. Will carp live if water is not running through pond?—A. Yes; all the better.

34. Will carp live in reservoirs of rain-water in Texas?—A. The rain-water might become too stagnant and injure them, but if kept sweet the carp could live. However, no more food should be put in than they can eat.

35. Will muddy water hurt carp?—A. No. It is their delight. They can usually get food from it.

36. Is well or spring water best adapted to carp?—A. It makes no difference. Neither is desirable.

37. Are streams suitable for trout good for carp?—A. No. Trout require clear, cold water; carp, warm water, and it need not be clear.

38. Are mineral waters bad for carp?—A. Cannot tell without knowing more about the mineral water. Brackish water is not injurious.

39. Will carp live in Rocky Mountain waters?—A. Probably live, but not grow much, because the water is too cold.

40. Will carp do well in limestone water?—A. Yes.

41. Is alkali water detrimental to carp?—A. Unknown.

VI.—PLANTS FOR CARP PONDS.

42. What plants are best for carp?—A. Crowfoots, cowslips, water-milfoil, bladderwort, hornwort, cress, water-rice, water-mace, water-oats, Indian rice, water-lilies—especially the last six.

43. Is grass in pond injurious to carp?—A. Not injurious.

44. Can water-cresses be too thick in a carp pond?—A. Yes. The pond must not be allowed to entirely grow up to vegetation.

VII.—THE CARE OF CARP.

45. Would carp succeed if placed in a common pond and left to take care of themselves?—A. About the same as when chickens and pigs are left to take care of themselves.

46. Can carp be placed in pond at any season of the year?—A. Yes; but do not transfer them suddenly from warm to cold or cold to warm water.

47. What is the best time of day to deposit carp?—A. When you can avoid a violent change in temperature.

48. Will horses going to water interfere with eggs?—A. No.

49. Will it harm carp to cut ice in pond where they are?—A. No. They will be so fast asleep in the mud they will not care.

VIII.—FOOD FOR CARP.

50. Do carp need feeding?—A. Yes, to grow fast. They can, however, pick for themselves just as chickens can.

51. What is best food for carp?—A. Cooked cereals and vegetables, such as corn, wheat, rye, potatoes, cabbage, turnip, lettuce, pumpkins, melons, &c.

52. How often should carp be fed?—A. As often as convenient, if food does not accumulate in their pond. You can habituate them to come to a place for food just the same as other animals. Better feed them morning and night, one or both.

53. Are boiled rice and corn bread suitable diet for carp?—A. Yes; excellent.

54. Is brewer's grain suitable feed for carp?—A. Yes.

55. Is it best to feed salad food to carp?—A. No harm.

56. Will kitchen scraps kill carp?—A. Not unless salt, pepper, and mineral substances are mixed in. Salt mackerel, salt meat, &c., should be excluded. Potatoes, corn, cabbage, lettuce, and other vegetables are suitable.

57. Are water-cresses essential for carp food?—A. Not essential, but desirable.

58. Will carp eat tadpoles?—A. No.

IX.—GROWTH OF CARP.

59. How large do carp grow?—A. Sometimes to 50 or 75 pounds.

60. How long does it take carp to grow?—A. It depends entirely on the temperature of the water and amount of food.

61. How much will a carp three years old weigh?—A. If in Pennsylvania, four or five pounds; if in Georgia, six to eight pounds. They can be forced to much greater weights by feeding.

62. What climate is best adapted to the carp?—A. Warm climate.

X.—SPAWNING OF CARP.

63. At what age and time of year do carp spawn?—A. Usually at the age of three years; often at two; sometimes at one in southern climates, when fed well. The month of spawning varies in different latitudes, but it usually occurs in May in the south and in June in the north. In cold water it may be protracted into July.

64. Will carp two years old spawn?—A. That depends on climate, food, &c.

65. At what age will the male carp vivify the eggs?—A. Probably younger than that at which the female deposits eggs.

66. How can one tell male from female?—A. It is impossible until about spawning time, unless you cut them open.

67. Which is the larger, male or female carp?—A. The female.

68. Do size of scales on carp indicate sex?—A. No.

69. Are carp prolific?—A. Yes; if properly cared for. A five-year-old carp ought to contain 500,000 eggs.

70. How many young will a pair of carp produce annually?—A. Very few, if left to themselves; a great number, if properly cared for—say 50,000.

71. What arrangements are to be made at spawning time?—A. Put the spawners by themselves till the eggs are deposited, and then protect the eggs from other animals. A good way is to put hemlock boughs in the pond to receive the eggs. These can be taken out covered with eggs and placed in water to hatch, where the eggs will not be eaten or destroyed. Keep the young out of the way of enemies.

72. Is it best to remove old fish from pond at spawning time?—A. It is a good idea. See answer to last question.

73. How long should young carp be kept in small pond before turning into larger pond with other fish?—A. Till large enough to defend themselves. Say till they weigh a pound each.

74. How distinguish carp spawn from frog or other spawn?—A. Carp spawn is deposited singly on branches, grasses, &c., and is about the size of number 8 shot. Frog spawn is deposited in a jelly-like mass.

75. Do young carp resemble tadpoles?—A. No.

XI.—ENEMIES OF CARP.

76. Will carp destroy their young?—A. Not if they can get any other food.

77. Will carp destroy other fish?—A. No. The carp does not injure any other fish, but is injured by many kinds.

78. Will dace hurt carp?—A. The minnows will eat the carp eggs.

79. Do frogs destroy the spawn of fish?—A. Yes; they eat both spawn and young fishes.

80. Will goldfish destroy carp and *vice versa*?—A. Yes. Besides they will mix—hybridize.

81. Will green frogs destroy carp?—A. Yes; they eat eggs and young carp.

82. Will minks destroy carp?—A.. Yes; they will exterminate them.

83. Will mud cat injure carp?—A. They will eat the eggs and young carp.

84. Will mud-turtles eat carp?—A. Yes, to extermination.

85. Will roaches feed on the carp spawn?—A. Yes.

86. Do snakes eat carp?—A. Yes.

87. Will suckers injure carp?—A. Yes.

88. Will trout destroy carp?—A. Yes.

89. How can one guard carp from frogs, tadpoles, water rats, and turtles?—A. Kill the frogs, tadpoles, rats, and turtles.

90. How can I get tadpoles out of the pond?—A. Drain the pond.

91. How get rid of catfish in carp ponds?—A. Drain the pond.

92. What varieties of fish can carp associate with without detriment?—A. There is no kind of fish that will not eat carp eggs and the young carp when they get the chance. Keep carp by themselves.

93. What varieties of fish are detrimental to carp culture?—A. See previous question and answer.

94. Will mountain and lake trout, salmon and carp thrive in the same pond?—A. No. Trout and salmon require cold, running water, and would eat carp eggs and young. The carp require warm, still water, and to be by themselves.

95. Will gum and holly trees in pond injure carp?—A. No.

96. Will mulberry trees around a pond hurt the fish?—A. No.

97. Will vegetable matter covered by water decompose and hurt the carp?—A. Yes; if in great quantities.

XII.—DISEASES OF CARP.

98. What is the cause of fungus on carp?—A. The cause is not known, but it results from a weak condition of the carp and from getting hurt.

99. What is the cure of fungus on carp?—A. Prevention is possible as shown by answer to previous question. No cure is yet known.

100. What is the cause of moldy appearance of carp?—A. This is the fungus spoken of in the two previous questions.

XIII.—HOW CARP CAN BE CAUGHT.

101. How are carp caught?—A. Best by a dip-net. They can be enticed by food into shallow water and then taken by a dipper, rake, or even by the hands.

102. Can carp be caught with hook and line?—A. Not very readily. They are shy biters, but a number have reported taking them with hooks baited with meat.

103. What bait is best to catch carp?—A. Teach them to come to a shallow spot or to a plank a few inches under water by feeding them at such a place, and while they are eating they can be taken in the hands full as readily as chickens are. They are very tame and will eat out of the hand.

XIV.—THE DISTRIBUTION OF CARP.

104. How can carp be obtained?—A. By filling out blank application to United States Fish Commission and sending through a United States Senator or Representative to Prof. S. F. Baird.

105. Who can indorse carp applications?—A. Members of Congress and Senators of the United States.

106. What time of the year do you distribute carp?—A. From October to April.

107. How old are the carp distributed?—A. Three to nine months.

108. Are carp distributed according to population of each State, or

according to number of applications?—A. According to number of applications.

109. How many fish per acre are required to stock a pond?—A. That depends on the amount of food available. A small pond may be made to produce thousands of carp. A pond one acre can be made to sustain 500 one-pound carp.

XV.—THE TRANSPORTATION OF CARP.

110. During transportation of fish will moss in the water prevent their being bruised?—A. Water-moss may be used to advantage, as it helps keep the water pure.

111. Is it safe to ship carp by stage?—A. They have been sent safely in a quart pail by all sorts of conveyances. It is essential that water enough remain in the pail to cover the carp.

112. Can young carp be carried on horseback?—A. Yes; by keeping them covered with water.

XVI.—FINANCIAL INQUIRIES.

113. What will carp cost?—A. The United States Fish Commission distributes them free. The recipient pays only the cost of transportation from Washington, or from such centers of supply as it establishes.

114. What are young carp worth per thousand?—A. The Government does not sell any. Private parties sometimes sell them at $5 per pair. A New Jersey carp-culturist advertises "selected minor carp at $85 per hundred, and selected scale carp at $80 per hundred; no orders filled for less than $25."

115. Can I raise 100 pounds carp cheaper than 100 pounds chicken?—A. Yes; as cheaply again.

116. How many pounds of carp per annum will a pond one acre square produce?—A. Very few if neglected; very many if wisely cared for. Five hundred one-pound carp ought to weigh 1,500 pounds the second year, and 2,500 pounds the third year.

117. Are carp known among fish-dealers?—A. They are a very important item with dealers in Europe. They were introduced into the United States so recently that but very few get into the markets yet. A correspondent in Saline County, Missouri, recently wrote that "large numbers of young carp, a foot long, are being taken from the Missouri River and sold in the market."

118. What are carp worth per pound in the market?—A. Very few have yet reached the markets in the United States.

UNITED STATES FISH COMMISSION,

Washington, D. C., August 8, 1883.

33.—DIRECTIONS CONCERNING THE CONSTRUCTION OF CARP PONDS.

[Condensed from the report of the Maryland Fish Commission for 1880.]

The cultivation of carp is of sufficient importance to fully warrant the construction of ponds for the purpose. But there already exist in many places ponds used for the collection of ice, or for supplying water to live stock, which could be converted into carp ponds at a comparatively small cost. There are also many depressions of surface in the lands which could be filled with water with but little labor, and made to answer the purpose admirably.

It is very desirable, on several accounts, that the ponds should be so constructed as to permit the water to be drawn off. The fish can then be captured and assorted, when those intended for breeding can be returned to the pond and the remainder placed in tanks from which to be taken, by the aid of dip-nets, as required for market or for food. Drawing off the water is also desirable for destroying such enemies of the fish as may be therein.

In the case of ponds supplied by the inflow of tide-water, eggs of other fishes are often wafted in, and the fish thus produced may consume the food, eggs, and young of the carp. By draining the ponds once or twice a year these intruders can be readily removed.

To utilize an ice pond for carp is very simple. It is not necessary that the drainage from the surrounding fields should be diverted, except when excessive in quantity or liable to become so after a heavy fall of rain. A certain amount of such drainage often proves beneficial, as considerable quantities of food are thus conveyed into the ponds. If admitted, an "overflow" must be provided, which should be well protected by wire-cloth screens to prevent the escape of the fish. This overflow constitutes the most important feature in the construction of a pond.

For illustration, Fig. 1 is a pond located in a meadow, through which flows a small stream. The pond is formed upon two sides by embankments of earth obtained by the removal of a portion of the soil from the inclosed space. The water may be supplied either by introducing it from the rivulet itself at some higher point, or, as in this illustration, from a spring in the adjacent meadow, supplemented by the surface drainage from the surrounding high land. A small tributary of the rivulet is utilized in this instance to carry off the surplus water, which is allowed to escape from the pond through the overflow O. A is the apparatus for emptying the pond. B is a frame inclosing the end of the discharge pipe leading from the pond, and provided with the screens *s s s*. C is

the "collector," into which the fish are drawn by the lowering of the water in the pond, and *c* a valve which controls the flow of the water

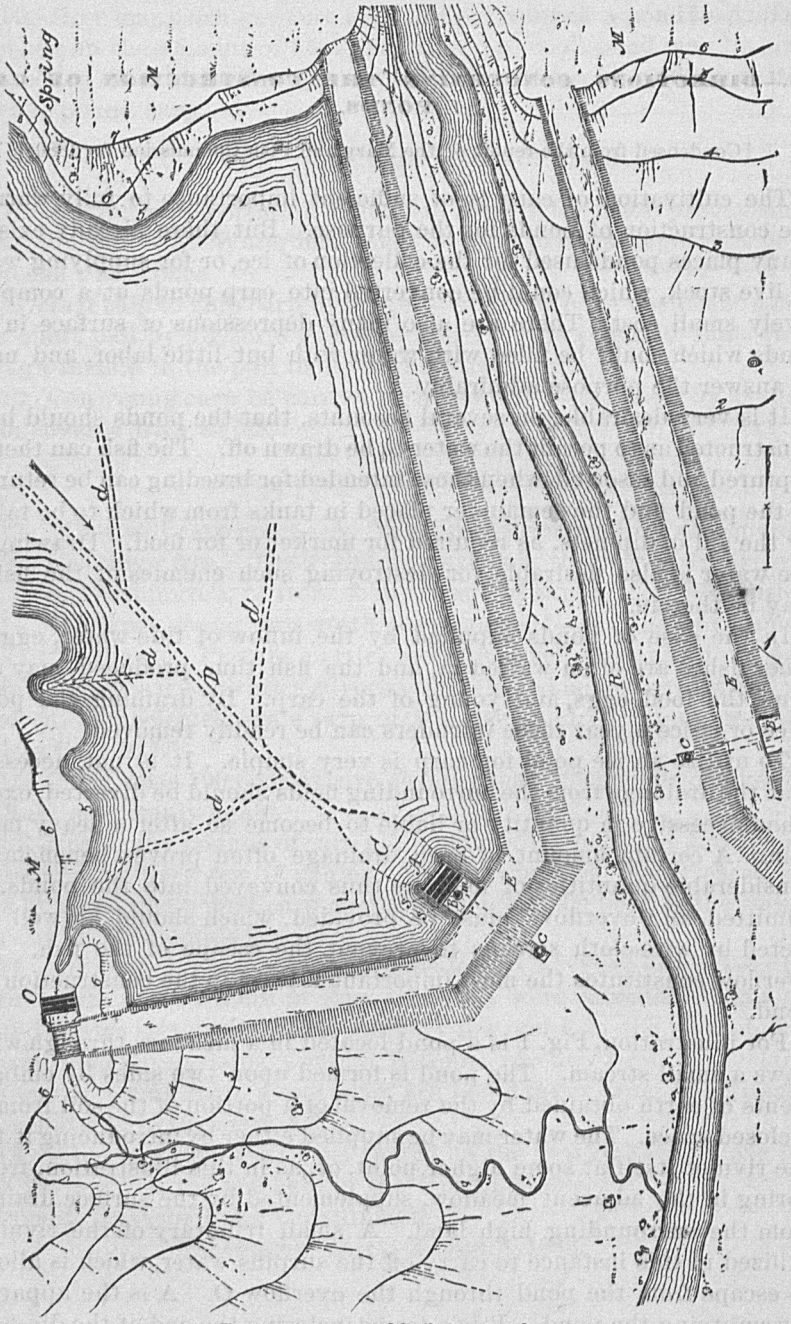


FIG. 1.—A carp pond built in a meadow.

through the discharge pipe *m*. D is a wide, shallow drain, having branches, *d d d d*, by means of which all of the water is led into the

collector when the pond is being emptied. E represents the embankments, which are about 6 feet in height at the angle of the pond in the lowest part of the meadow.

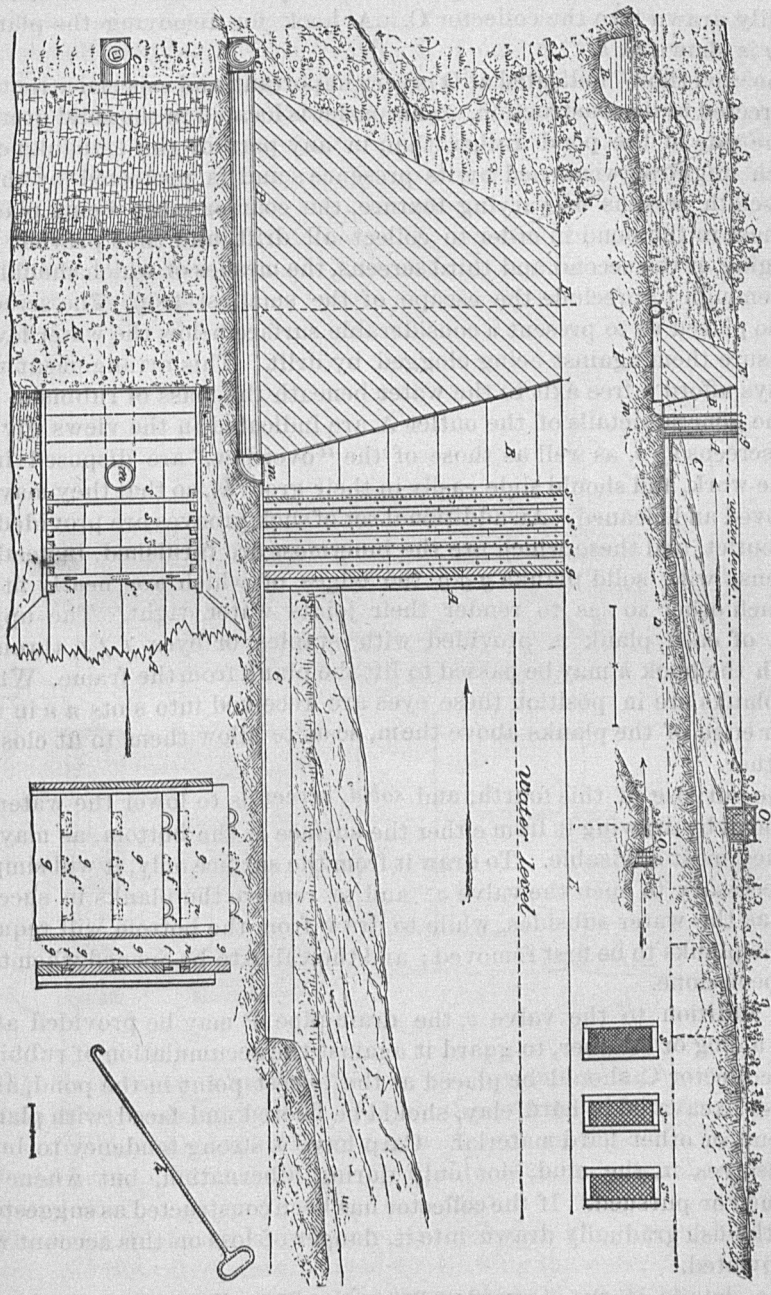


FIG. 2.—Sectional view of the dam of carp pond.

In Fig. 2 the upper portion presents a longitudinal section of the pond. The lower part shows a portion of the same section enlarged, so that the arrangement of the pond is clearly illustrated. The fish are readily drawn into the collector C. A hook for removing the planks *g g g* is shown at *h*.

The "overflow" indicated at O is very important, and especial attention is directed to its construction. This outlet is located in the solid ground at the side of the pond rather than in any part of the embankment, which might be weakened by its presence; and is protected by three wire-cloth screens of varying texture, the coarser mesh being placed farthest in the pond in order to collect all drift, and thus prevent the clogging of the second and third screens, the meshes of which should be fine enough to preclude the escape of the smallest fish. The screens are so placed as to present a considerable surface below the water-level, to insure them against being clogged by drift. This arrangement will always afford a free exit to the water beneath the mass of rubbish.

The general details of the outlet A are indicated in the views given. The screens *s s s*, as well as those of the "overflow," are disposed in a frame-work, and should slide easily in their grooves, so that they may be removed and cleaned. An additional set of such grooves are provided at this outlet, and these which are the innermost are furnished, instead of screens, with solid planks *g g g* the edges of which are neatly fitted to each other so as to render their joints water tight. The upper edge of each plank is provided with staples or eyes *f f f*, through which the hook *h* may be passed to lift the plank from the frame. When the planks are in position these eyes are received into slots *n n* in the lower edge of the planks above them, so as to allow them to fit closely together.

The purpose of this fourth, and *solid*, screen is to lower the water in the pond by drawing it from either the surface or the bottom, as may be deemed most advisable. To draw it from the surface only, it will simply be necessary to open the valve *c*; and to remove the planks in succession as the water subsides, while to draw from the bottom will require all the planks to be first removed; and the valve to be opened when this has been done.

In addition to the valve *c*, the drain-pipe P may be provided at *m* with a clog or strainer, to guard it against the accumulation of rubbish. The collector C should be placed at the lowest point in the pond, and, unless excavated in hard clay, should be floored and faced with plank, cement, or other hard material. Carp have a strong tendency to bury themselves in the mud, not only during hibernation, but whenever alarmed or pursued. If the collector has been constructed as suggested, and the fish gradually drawn into it, danger of loss on this account will be obviated.

The details of the "overflow," "outlet," "collector," &c., may be varied, according to the circumstances; but the general requirements

of a pond so located as to receive its supply of water at one end and to discharge it at the other are here indicated.

Ponds should not be less than three feet in depth at their deepest part—to insure the fish against being frozen in severely cold weather—and should gradually lessen to a depth of one or two inches to provide the shoals required for spawning. Small knolls and islands should be removed, as they generally afford harbor for the enemies of carp.

FOR PONDS IN TIDAL REGIONS.—The collector and drain ditches should be constructed and arranged as above, the collector being formed at the lowest point within the embankment. The "overflow" may be omitted, as the "flume" can be readily adapted to the purposes of carrying off any surplus water. As the flume requires constant attention to insure its operation, the "overflow" should be retained, if practicable, and be placed in firm ground.

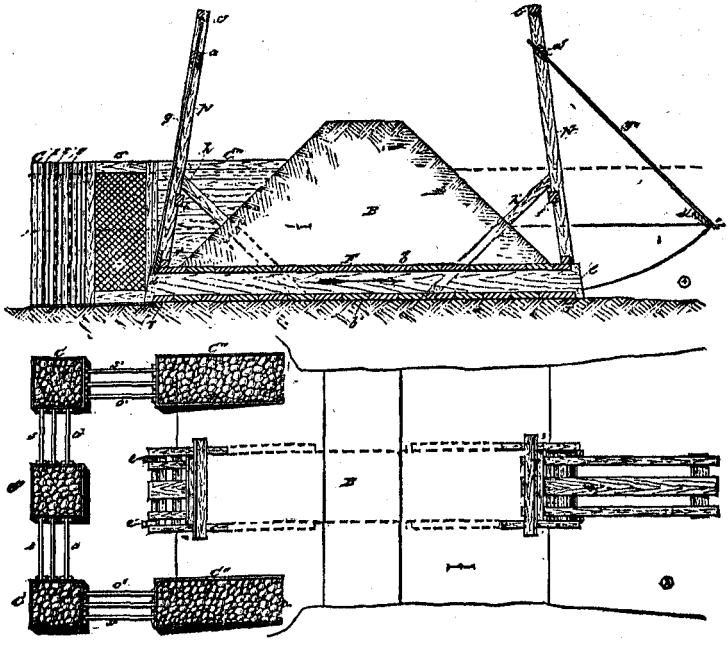


FIG. 3.

Fig. 3 represents a vertical section, and corresponding horizontal projection of the embankment B, showing the position of the flume F, and its controlling valves, *d d*, together with that of the crib-work "C C C," which is constructed on the pond side, and is designed to support the screens.

The flume is placed, as before, on a level with the bottom of the collector, and the valves are arranged for drawing the water *from* the pond, at ebb tide. The inner valve has been slightly raised by *sliding* upward its support *g* through the grooved trunnion *a*; and the pressure

of the water flowing through the flume, in the direction of the arrow, serves to *swing* open the outer valve, and to keep it open until the pond is emptied or the tide turns. In the latter event the outer valve closes

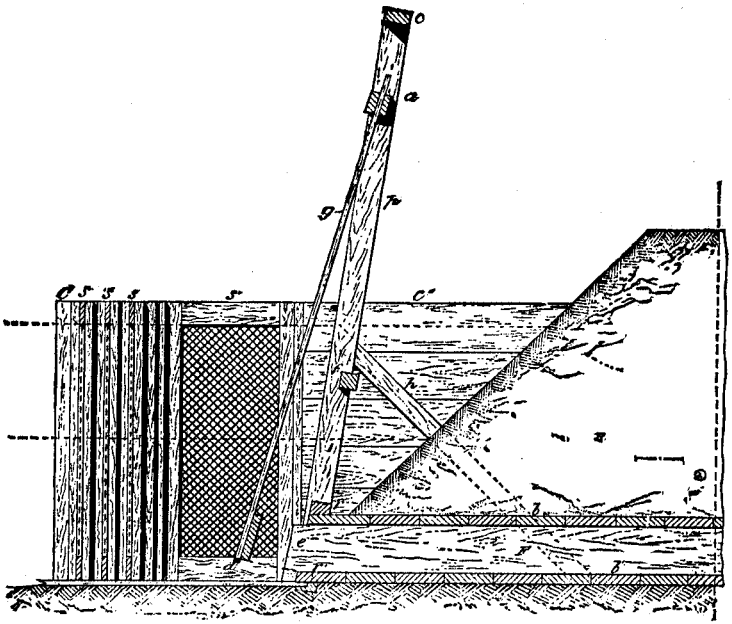


FIG. 4.

automatically until the level of the water without again falls below that of the water remaining in the pond when its operation is resumed.

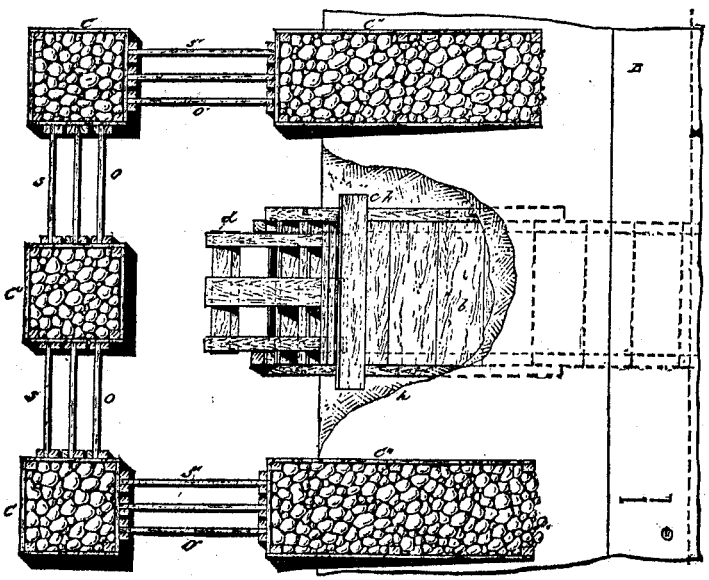


FIG. 5.

Should it be desired, on the other hand, to admit water from the river *into* the pond—at the proper levels—the relative positions and operations of the valves would, of course, be reversed. The outer valve should then be raised so as to allow the water to enter the flume from the river; and the inner valve should be lowered, in turn, to permit it to swing with the current, and to close automatically with the cessation of its flow.

Figs. 4, 5, 6, and 7 represent portions of the above considerably enlarged for the purposes of a more detailed description. The flap-valve *d*, which is here represented as being forced slightly open by the presence of the inflowing current, is attached to the lower extremities of the long strips or pieces *g g g*, arranged to slide upward through mortises in the beam *a*. The latter, in turn, is provided at each end with trun-

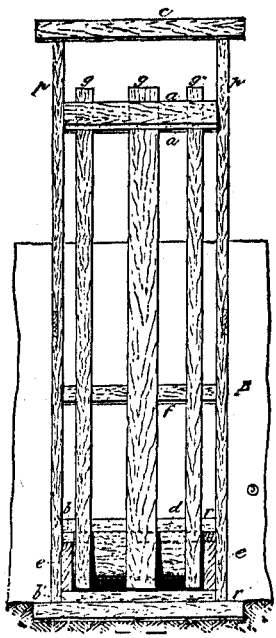


FIG. 6.

nions fitting loosely into corresponding sockets in the uprights *p p*, by which means the beam and its dependent parts are allowed to swing readily in place, as indicated by the positions of the gate or valve in the several diagrams.

Another and fixed beam, indicated at *f*, serves as an additional support to the uprights *p p*, and as the fulcrum of a lever by means of which the gate may be raised or lowered. "C C C" represent cribwork, filled with stones, and sustaining in position the screens *s s* and *o o*, which are arranged to slide in their respectitive grooves, similarly to those already described.

Fig. 7 is a flume or trunk of simpler design which may be constructed

by hollowing out one side of a stout log, for nearly its entire length, and covering the groove thus formed with pieces of thick plank. The bark should be allowed to remain undisturbed, where practicable, for a protection to the wood. The general arrangement of the flume and its valves is indicated in the diagram. As the valves do not work automatically, such a "plug-trunk"—as it is called—would appear to be better adapted for ponds located in other than tidal regions.

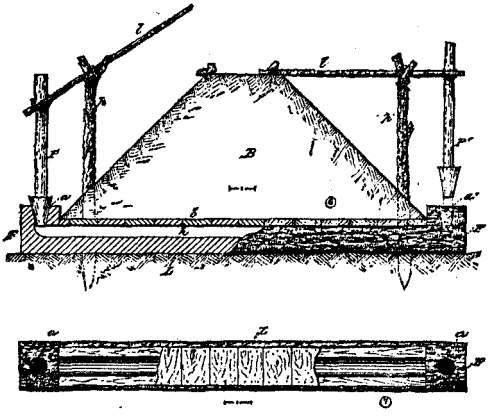


FIG. 7.

So much of the wood-work, in all these constructions, as is exposed to the air, and particularly such parts as are subject to the alternate action of the air and water, are liable to decay, and should be protected by thick coatings of paint, or other preservative material. Such parts as are imbedded in the earth will last for years.

34.—SPAWNING OF CALIFORNIA MOUNTAIN TROUT, REARED IN CONFINEMENT, FROM EGGS BROUGHT FROM McCLOUD RIVER.

By FRANK N. CLARK.

[From a letter to Prof. S. F. Baird.]

Our rainbow trout have just commenced spawning. The first eggs were taken day before yesterday, and we now have about 5,000. They are from three-year old fish that were hatched and grown at this station. There is a marked difference in appearance between these eggs and those of same kind direct from California, ours being identical in size and color with brook-trout eggs.

NORTHVILLE, MICH., *February* 15, 1883.

Vol. III, No. 17. Washington, D. C. Sept. 6, 1883.

35.—MARSH AND AQUATIC PLANTS OF THE NORTHERN UNITED STATES, MANY OF WHICH ARE SUITABLE FOR CARP PONDS.

By LESTER F. WARD.

The species indicated by the heavy-faced type are strictly aquatic. Those which are especially recommended by Dr. Hessel for carp ponds are Nos. 7, 8, 18, 19, 20, 21, 22, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 67, 81, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114. Those which occur near Washington are numbers 2, 4, 6, 7, 9, 11, 13, 14, 15, 16, 17, 23, 25, 26, 27, 29, 31, 32, 35, 36, 38, 40, 41, 51, 58, 60, 61, 63, 65, 66, 68, 69, 72, 73, 74, 75, 76, 77, 78, 80, 81, 82, 83, 84, 85, 86, 89, 95, 96, 97, 100, 104, 105, 106, 116, 121, 123, 125, 128, 129, 131, 133, 134, 135, 136, 138, 143, 145, 147, 151, 154, 155, 157, 158, 160, 161, 162, 166, 168, 171, 174, 178, 180.

RANUNCULACEÆ.

CROWFOOT FAMILY.

1. *Ranunculus hederaceus*, L. Introduced near Hampton, Va.
2. *Ranunculus ambigens*, Watson. [*R. alismæfolius*, Geyer.] Water-Plantain Spearwort. Eastern Branch marsh, D. C.; also marsh near the mouth of Hunting Creek, Va.
3. *Ranunculus flammula*, L. Smaller Spearwort. Shore of Lake Ontario and northward.
4. *Ranunculus pusillus*, Poir. Small Spearwort. Potomac Flats above Eads Mill, D. C.
5. *Ranunculus cymbalaria*, Pursh. Seaside Crowfoot. Sandy shores from New Jersey northward, and along the great lakes to Illinois and westward.
6. *Ranunculus sceleratus*, L. Cursed Crowfoot. Common everywhere.

NYMPHÆACEÆ.

WATER-LILY FAMILY.

7. **Brasenia peltata**, Pursh. Water-Shield. Carberry Meadows below Eads Mill, D. C.
8. **Nelumbium luteum**, Willd. Yellow Nelumbo, or Water Chinquepin. Waters of the Western and Southern States; rare in the Middle States; introduced into the Delaware below Philadelphia. Near Woodstown and Sussex County, New Jersey. Big Sodus Bay, Lake Ontario, and in the Connecticut near Lyme.

9. **Nuphar advena*, Ait. Yellow Pond-Lily. Spatter Dock. Common everywhere.
10. **Nuphar sagittæfolium*, Pursh. North Carolina and southward.

CRUCIFERÆ.

MUSTARD FAMILY.

11. *Cardamine rhomboidea*, D. C. Spring-Cress. Common.
12. *Cardamine rotundifolia*, Michx. Mountain Water-Cress. Pennsylvania, and southward along the mountains.
13. *Cardamine hirsuta*, L. Bitter Cress. Common.

HYPERICACEÆ.

ST. JOHN'S-WORT FAMILY.

14. *Elodes Virginica*, Nutt. Marsh St. John's-wort. Common.

LEGUMINOSÆ.

PULSE FAMILY.

15. *Lathyrus palustris*, L. Marsh Vetchling. New England to Pennsylvania, Illinois, and northward.

CRASSULACEÆ.

ORPINE FAMILY.

16. *Penthorum sedoides*, L. Ditch Stone-crop. Common everywhere.

HALORAGEÆ.

WATER-MILFOIL FAMILY.

17. **Myriophyllum spicatum**, L. Water-Milfoil. Below Alexandria, Va.
18. **Myriophyllum verticillatum**, L. Common.
19. **Myriophyllum heterophyllum**, Michx. Lakes and rivers, from Northern New York, westward and southward.
20. **Myriophyllum scabratum**, Michx. From Southern New England and Ohio, southward.
21. **Myriophyllum ambiguum**, Nutt. Massachusetts to New Jersey, Pennsylvania and southward, near the coast.
22. **Myriophyllum tenellum**, Bigelow. Northern New York, New England, and northward.
23. **Proserpinaca palustris**, L. Mermaid-weed. Not rare.
24. **Proserpinaca pectinacea**, Lam. Swamps near the coast.

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* Pronounced injurious to carp ponds by Dr. Hessel.

ONAGRACEÆ.

EVENING PRIMROSE FAMILY.

25 *Jussiæa decurrens*, D. C. Virginia to Illinois and southward.
26. *Ludwigia palustris*, Ell. Water Purslane. Common; also in Europe.

LYTHRACEÆ.

LOOSESTRIFE FAMILY.

27. *Ammannia humilis*, Michx. Tooth-cup. Massachusetts to Michigan, Illinois, and southward. Flats of Potomac, D. C.
28 *Ammannia latifolia*, L. Ohio, Illinois, and southward.
29. *Nesæa verticillata*, H. B. K. Swamp Loosestrife. Flats of Potomac.

UMBELLIFERÆ.

PARSLEY FAMILY.

30. *Hydrocotyle repanda*, Pers. Water Pennywort. Maryland and southward.
31. *Hydrocotyle ranunculoides*, L. Shores of Potomac, Maryland.
32. *Hydrocotyle Americana*, L. Common, northward.
33. *Hydrocotyle umbellata*, L. Massachusetts, on the coast to Pennsylvania.
34. *Hydrocotyle interrupta*, Muhl. Massachusetts to Virginia and southward along the coast.
35. *Eryngium Virginianum*, Lam. Eryngo. Button Snakeroot. New Jersey and southward.
36. *Discopleura capillacea*, D. C. Mock Bishop-weed. Massachusetts to Virginia, and southward. Near Custis Spring, Va.
37. *Cicuta bulbifera*, L. Water-Hemlock. Common, northward.
38. *Sium cicutæfolium*, Gmel. Water-Parsnip. Common.
39. *Sium angustifolium*, L. Massachusetts, Michigan, Illinois, westward. Europe.

COMPOSITÆ.

COMPOSITE FAMILY.

40. *Bidens cernua*, L. Smaller Bur-Marigold. Virginia to Wisconsin and southward.
41. *Bidens chrysanthemoides*, Michx. Larger Bur-Marigold. Common.
42. ***Bidens Beckii**, Torr. Water Marigold. Massachusetts to New Jersey, Illinois, and northward.

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* Pronounced injurious to carp ponds by Dr. Hessel.

LOBELIACEÆ.

Lobelia Family.

43. **Lobelia paludosa**, Nutt. Delaware and southward.
44. **Lobelia Dortmanna**, L. Water Lobelia. Northern Pennsylvania to New England.

LENTIBULACEÆ.

Bladderwort Family.

45. **Utricularia inflata**, Walt. Inflated Bladderwort. Maine to Virginia and southward.
46. **Utricularia minor**, L. Smaller Bladderwort. Rhode Island to Illinois and northward.
47. **Utricularia clandestina**, Nutt. Eastern New England, Western New York, and New Jersey.
48. **Utricularia intermedia**, Hayne. New England and New Jersey to Ohio, Wisconsin, and northward.
49. **Utricularia striata**, Le Conte. Long Island, New Jersey, and southward.
50. **Utricularia biflora**, Lam. Illinois and southward.
51. **Utricularia gibba**, L. Virginia to Massachusetts, Northern New York and Northern Illinois.
52. **Utricularia purpurea**, Walt. Maine to Virginia and southward.
53. **Utricularia resupinata**, Greene. Eastern Maine to Rhode Island.
54. **Utricularia cornuta**, Michx. Common.
55. **Utricularia subulata**, L. New Jersey, Virginia and southward.

SCROPHULARIACEÆ.

Figwort Family.

56. *Herpestis rotundifolia*, Pursh. Illinois and southward.
57. *Herpestis amplexicaulis*, Pursh. New Jersey and southward.
58. *Gratiola Virginiana*, L. Hedge-Hyssop. Common.
59. *Gratiola sphærocarpa*, Ell. New Jersey to Illinois and southward.
60. *Ilysanthes gratioloides*, Benth. False Pimpernel. Common.
61. **Micranthemum Nuttallii**, Gray. Banks of the Delaware River and southward.
62. *Limosella aquatica*, L., var. *tenuifolia* Hoffm. From New Jersey northward.
63. *Gerardia purpurea*, L. Purple Gerardia. Maine to Wisconsin and southward.

LABIATÆ.

MINT FAMILY.

64. *Mentha rotundifolia*, L. Round-leaved Mint. Maine, New Jersey, and Pennsylvania.
65. *Mentha viridis*, L. Spearmint. Common (natural. from Europe).
66. *Mentha piperita*, L. Common (natural. from Europe).
67. *Mentha aquatica*, L. Water Mint. Delaware.
68. *Lycopus Virginicus*, L. Bugle-weed. Common, especially northward.
69. *Physostegia Virginiana*, Benth. False Dragonhead. Western New York to Wisconsin and southward. Rocks, Potomac shore.

GENTIANACEÆ.

GENTIAN FAMILY.

70. **Limnanthemum lacunosum**, Griesbach. From Maine and New York to Virginia and southward.
71. **Limnanthemum trachyspermum**, Gray. Floating Heart. Maryland and southward.

POLYGONACEÆ.

BUCKWHEAT FAMILY.

72. *Polygonum arifolium*, L. Halberd-leaved Tear-thumb.
73. *Polygonum hydropiperoides*, Michx. Mild Water-pepper.
74. *Polygonum sagittatum*, L. Arrow-leaved Tear-thumb. Common.

PIPERACEÆ.

75. *Saururus cernuus*, L. Lizard's-tail. Common.

URTICACEÆ.

NETTLE FAMILY.

76. *Pilea pumila*, Gray. Richweed; Clearweed.
77. *Bœhmeria cylindrica*, Willd. False Nettle. Common.

ARACEÆ.

ARUM FAMILY.

78. *Peltandra Virginica*, Raf. Arrow Arum. Common.
79. *Calla palustris*, L. Water Arum. New England to Pennsylvania, Wisconsin, and common northward.
80. *Orontium aquaticum*, L. Golden-Club. Massachusetts to Virginia, and southward.

LEMNACEÆ.

DUCK-WEED FAMILY.

81. **Lemna polyrrhiza**, L. Duck-weed; Duck's Meat.

TYPHACEÆ.

CAT-TAIL FAMILY.

82. *Typha latifolia*, L. Common Cat-tail; Reed-mace. Common.
83. *Typha angustifolia*, L. Small Cat-tail; Narrow-leaved Cat-tail. (Europe.)
84. *Sparganium eurycarpum*, Eng. Bur-reed. New England and Pennsylvania, northward and westward.
85. *Sparganium simplex*, Hudson. New England and northward. (Europe.)

NAIADACEÆ.

PONDWEED FAMILY.

86. **Naias flexilis**, Rostk. Naiad. Common. (Europe.)
87. **Zannichellia palustris**, Micheli. Horned Pondweed. Rather rare. (Europe.)
88. **Potamogeton amplifolius**, Tuckerman. Pondweed. Not rare.
89. **Potamogeton Claytonii**, Tuckerman. Common.
90. **Potamogeton compressus**, L. Not common.
91. **Potamogeton crispus**, L. Delaware, Pennsylvania, and New Jersey.
92. **Potamogeton gramineus**, L. The commonest form. (Europe.)
93. **Potamogeton gramineus**, L., var. spathulæformis, Robbins.
94. **Potamogeton gramineus**, L., var. myriophyllus, R.
95. **Potamogeton hybridus**, Michx.
96. **Potamogeton lonchites**, Tuckerman. New England to Illinois.
97. **Potamogeton lucens**, L. Not common. In the Potomac.
98. **Potamogeton lucens**, L., var. minor, Nolte.
99. **Potamogeton lucens**, L., var. Connecticutensis, R.
100. **Potamogeton natans**, L. Common. (Europe.)
101. **Potamogeton Niagarensis**, Tuck. Rapids above Niagara Falls.
102. **Potamogeton Oakesianus**, Robbins. Not rare in Eastern Massachusetts.
103. **Potamogeton obtusifolius**, Mertens & Koch. Very rare. Pennsylvania and Michigan.
104. **Potamogeton pauciflorus**, Pursh. Common.
105. **Potamogeton pectinatus**, L. Common.
106. **Potamogeton perfoliatus**, L. Common.
107. **Potamogeton prælongus**, Wulfen. East New England and along the Great Lakes to Lake Superior.

108. **Potamogeton pulcher**, Tuckerman. Eastern Massachusetts, Missouri, Georgia.

109. **Potamogeton pusillus**, L. Very common, especially southward.

110. **Potamogeton Robbinsii**, Oakes. New England, New York, Pennsylvania, and Ohio.

111. **Potamogeton rufescens**, Schrad. New England to Pennsylvania, Illinois, and especially northward.

112. **Potamogeton spirillus**, Tuckerman. Maine to Lake Superior and Virginia.

113. **Potamogeton Tuckermani**, Robbins. White Mountains, New Hampshire, to Pennsylvania.

114. **Potamogeton Vaseyi**, Robbins. Illinois, Massachusetts.

ALISMACEÆ.

WATER-PLANTAIN FAMILY.

115. *Scheuchzeria palustris*, L. New England to Pennsylvania, Illinois, and northward.

116. *Alisma plantago*, L., var. Americanum, Gray.

117. *Echinodorus parvulus*, Engelm. Massachusetts and Michigan to Illinois.

118. *Echinodorus rostratus*, Engelm. Illinois and southward.

119. *Echinodorus radicans*, Engelm. Illinois and southward.

120. *Sagittaria lancifolia*, L. Arrowhead. Virginia, and southward to the West Indies.

121. *Sagittaria variabilis*, Engelm. New Jersey and southward.

122. *Sagittaria calcyna*, Engelm. Maine to Delaware, Wisconsin, and southward.

123. *Sagittaria heterophylla*, Pursh.

124. *Sagittaria graminea*, Michx. Rather common, especially southward.

125. *Sagittaria pusilla*, Nutt. From Eastern New Jersey and Philadelphia southward, near the coast.

126. **Sagittaria natans**, Michx.

HYDROCHARIDACEÆ.

FROG'S-BIT FAMILY.

127. **Limnobium Spongia**, Richard. American frog's-bit. Lake Ontario, Illinois, and in the Southern States.

PONTEDERIACEÆ.

PICKEREL-WEED FAMILY.

128. **Pontederia cordata**, L. Pickerel-weed. Common.

129. *Heteranthera reniformis*, Ruiz. and Pav. Mud Plantain.

130. *Heteranthera limosa*, Vahl. West Virginia to Illinois and southward.

XYRIDACEÆ.

YELLOW-EYED GRASS FAMILY.

131. *Xyris flexuosa*, Muhl. Yellow-eyed Grass. Eastern Massachusetts southward near the coast; also Illinois, Wisconsin, and Michigan.
132. *Xyris Caroliniana*, Walt. Rhode Island to Virginia and southward.

CYPERACEÆ.

SEDGE FAMILY.

133. *Cyperus phymatodes*, Muhl. Vermont to Wisconsin, and common southward.
134. *Cyperus virens*, Michx. Virginia and southward.
135. *Dulichium spathaceum*, Pers. Common.
136. *Fuirena squarrosa*, Michx. Massachusetts to Virginia and southward; also Michigan.
137. *Eleocharis acicularis*, R. Br. Common. (Europe.)
138. *Eleocharis compressa*, Sullivant. Northern New York to Ohio and Illinois.
139. *Eleocharis equisetoides*, Torr. Rhode Island, Michigan, Delaware, and southward.
140. *Eleocharis intermedia*, Schultes. New York and Pennsylvania to Illinois and northward.
141. *Eleocharis melanocarpa*, Torr. Massachusetts to Virginia, and southward.
142. *Eleocharis microcarpa*, Torr. New Jersey and southward.
143. *Eleocharis obtusa*, Schultes. Most common.
144. *Eleocharis olivacea*, Torr. Massachusetts to New Jersey; also shore of Lake Ontario.
145. *Eleocharis palustris*, R. Br. Very common.
146. *Eleocharis pygmæa*, Torr.
147. *Eleocharis quadrangulata*, R. Br. New York, Michigan, and southward.
148. *Eleocharis Robbinsii*, Oakes. New Hampshire to New Jersey and southward.
149. *Eleocharis rostellata*, Torr. Rhode Island, East Massachusetts, and Vermont to New Jersey, Virginia, Michigan, and southward.
150. *Eleocharis simplex*, Torr. Eastern shore of Maryland and southward.
151. *Eleocharis tenuis*, Schultes. Common.
152. *Scirpus Canbyi*, Gray. Maryland.
153. *Scirpus cæspitosus*, L. New York and Northern Illinois.

154. *Scirpus debilis*, Pursh. Massachusetts to Virginia and southward.
155. *Scirpus fluviatilis* (Club-rush), Gray. Western Vermont to Pennsylvania, Wisconsin, and Illinois.
156. *Scirpus maritimus*, L. Common on the coast and near salt springs in the interior of New York.
157. *Scirpus eriophorum*, Michx. Wool-grass. Clump-head Grass.
158. *Scirpus lineatus*, Michx.
159. *Scirpus Olneyi*, Gray. Rhode Island to Delaware and southward.
160. *Scirpus atrovirens*, Muhl.
161. *Scirpus polyphyllus*, Vahl. West, New England to Illinois, and common southward.
162. *Scirpus pungens*, Vahl. Very common. (Europe.)
163. *Scirpus Smithii*. Wet shores, Lake Ontario to Illinois and Delaware Bay.
164. *Scirpus subterminalis*, Torr. New Jersey and New England to Michigan and westward.
165. *Scirpus supinus*, L. var. Hallii. Illinois and southwestward.
166. *Scirpus sylvaticus*, L. Eastern Massachusetts, New York.
167. *Scirpus Torreyi*, Olney. New England to Pennsylvania and Michigan.
168. *Scirpus validus*, Vahl. Great Bulrush. Common everywhere.
169. *Eriophorum alpinum*, L. Cotton Grass. New England to Pennsylvania, Wisconsin and northward.
170. *Eriophorum vaginatum*, L. New England to Pennsylvania, Wisconsin and northward.
171. *Eriophorum Virginicum*, L. Common.
172. *Eriophorum polystachyon*, L. Common northward.
173. *Eriophorum gracile*, Koch. New England to Illinois and northward.
174. *Rhynchospora alba*, Vahl. Beak-Rush. (Europe.)
175. *Rhynchospora macrostachya*, Torr. Massachusetts, Rhode Island, New Jersey, and southward.
176. *Rhynchospora scirpoides*, Gray. Rhode Island, Massachusetts.
177. *Carex aquatilis*, Wahl. New England to Wisconsin.
178. *Carex riparia*, Curtis. (Europe.)
179. *Carex trichocarpa*, Muhl. (Common.)

GRAMINEÆ.

GRASS FAMILY.

180. *Eragrostis reptans*, Nees. Common.
181. *Arundinaria tecta*, Muhl. Small Cane. Virginia, Illinois, and southward.

WASHINGTON, D. C., *June* 20, 1882.

36.—AN IMPORTANT FISH-WAY CAUSE.

By MERWIN P. SNELL.

The case of William Parker *versus* The People of the State of Illinois has come to the supreme court of Illinois on a plea of error from the circuit court of Kendall County. It is a somewhat important one from a fish-cultural point of view, as it involves the question whether or not a land-owner upon an unnavigable stream can acquire a prescriptive right to obstruct the passage of fish by a dam which has no fish-way.

Mr. William Parker, the plaintiff in error, owns a flour mill and a furniture factory, which are situated upon his own land, on opposite sides of the Fox River, in Kendall County, the necessary machinery being moved by water-power supplied through the means of a dam with a six-foot head. An Illinois statute, similar to ones existing in many of the States, makes it the duty of all persons owning or erecting dams to furnish them with suitable fish-ways, so that the migrating species of fish may have free passage to and from their spawning-grounds. Mr. Parker, convicted before a justice of the peace for a violation of this act, appealed to the circuit court, in which judgment being rendered against him, he prosecutes a writ of error in the supreme court of the State.

The rather elaborate argument of the counsel for the people, Messrs. Eugene Canfield and R. P. Goodwin, appears in the Forest and Stream for April 5, 1883, under the heading The Fox River Fish-way Case.

It had been claimed in behalf of Mr. Parker that the stream not being a navigable one, the right of fishing therein did not belong to the public, but was vested in the riparian proprietors, and that, as the dam had been in existence for about fifty years without having caused any complaint on the part of the other proprietors, its owner had acquired against them a prescriptive right to prevent the passage of fish.

It was also held that the general act under which he was prosecuted was unconstitutional, since it impaired the obligations of the contract contained in a certain private act, passed in 1857, which allowed one of his remote grantors the right to increase the height of the dam in question, and thus to cause the water of the stream to overflow the lands of neighboring proprietors, upon making due reparation.

This latter branch of the argument has little general interest, as the case is in this particular an unusual one, and the disputed points are outside the range of what may be properly termed fishery law; it will be sufficient to say that the counsel for the people seem to have demonstrated, not only that nothing secured by the private act was affected by the provision regarding the erection of fish-ways, but that the private act itself had become void on the adoption of the State constitution of 1870.

The first point, however, is one of considerable interest, and it may be worth while to present the principal points of the argument in detail.

I. It is claimed by the plaintiff in error that, the stream being unnavigable, the question is one of private right, in which the people of the State at large have no interest.

On the part of the people it is held: (1) That the fish, which are called "game fish" in the statutes of the State, are game in the same sense that birds and mammals not domesticated are (*vide* Phelps *vs.* Racey, 60 N. Y., 10), and have the same legal status. The fact that they live in the water instead of in the air or upon the land makes no difference. (2) "The ownership of all fish and game which are free or not domesticated within the State, is in the State as the sovereign power, * * * the right of capture being * * * a mere boon, expressly or impliedly permitted by the State to the citizen, to be limited or revoked at pleasure (Wagner *vs.* The People, 97 Ill., 320)." (3) "This being so, the prescriptive rights claimed against the riparian owners who happen in this regard to be injuriously affected by the obstruction to the free passage of fish amount to nothing. If, outside of the question of prescription, the State, under what is called the police power, has a right to regulate the passage of fish in the natural streams of the State for the benefit of the people, or any portion of them, no prescriptive right can be set up by one who maintains an obstruction in such a stream against the will of the legislature expressed under the forms required by its organic law. One who had owned and occupied land in this State for twenty years before the enactment of the first act of our legislature making it unlawful to kill prairie chickens during a certain portion of the year, might as well be allowed to set up as a defense to a prosecution for violating the act, that he had for the entire period of twenty years killed every bird of that species which had come upon his land during the prohibited season, and so had a prescriptive right to set the law of the State at defiance."

II. It is claimed by the plaintiff that since the right concerned is a private one, it may be prescribed for like other private rights; and he having exercised it freely for nearly half a century, may clearly claim it now by prescription.

On the other hand, leaving out the question of the police power of the State, mentioned in the quotation just above, it is held: (1) That it is well established that the time giving the right to any servitude (as in this case giving to the owner of the dam the right to prevent fish by it from reaching the lands of his neighbors) "does not begin to run until the injury is done and becomes apparent." (See Washburn on Easements, pp. 128, 129, 355, 468, and 530.) (2) That "it was not until a very recent period that it became known that the spawning beds of the most valuable fish which naturally frequent the stream in question, which largely supply this stream, were the bayous and overflowed lands along the Illinois and Mississippi Rivers, and that these mill-dams in any very

material respect tended to the depopulation of the streams of such fish." (3) That, since the injury must be apparent when the time giving the prescriptive right commences to run (1), and since the injury in this case was not apparent until shortly before the time when the right was called in question (2), it must follow that Mr. Parker cannot claim a prescriptive right to obstruct the passage of fish by his dam. (4) That no one can prescribe for a public nuisance (Washburn on Easements, p. 481). *a.* "The appropriation to one's self of public property which should be common to all is a *purpestre* and a public nuisance (Wood on Nuisances, § 14; Downing *vs.* The City of Aurora, 40 Ill., 481)." *b.* "The fouling of a stream with waste from mills, like sawdust and the like, is of the same character (Weazie *vs.* Divinel, 50 Minn., 495, 496; David *vs.* Winslow, 51 Maine, 93; Gerrick *vs.* Brown, *Ib.*, 256)." *c.* "From these cases it appears that any use of property in a stream which violates that 'golden rule of the law' (State *vs.* Glen, 7 Jones, N. C., 327) *Sic utere tuo ut non alienum lædas*, especially when it affects a large number of the citizens of the State, constitutes a nuisance." *d.* Hence the right to maintain an impassable dam, and thus deprive a water-course of fish, is a public nuisance and cannot be prescribed for.

This is a test case, and upon its decision may largely depend the success or failure of the efforts which are being made for the restocking of those waters of the State concerned from which the most highly-esteemed food-fishes have been driven by the encroachments of the manufacturing interests. It is somewhat doubtful whether the common law recognizes fish in an unnavigable stream to be in any sense public property, and if it shall be held that the owner of a dam may acquire by prescription a right to interrupt by its means the migrations of fish, in the face of a law requiring the erection of fish-ways, the latter will become a dead letter and the good end for which it was devised will fail of accomplishment. It does not seem probable, however, that such a decision will be made, especially in view of the opinion of the Supreme Court of the United States in the case of Holyoke County *vs.* Lyman (15 Wallace, 500), which is cited by Messrs. Canfield and Goodwin in that portion of their argument bearing upon the question of the private act mentioned in the first part of this article. They observed that by the Supreme Court "it was held that the right to have migratory fishes pass in their accustomed course up and down rivers and streams, though not technically navigable, was a public right, and might be regulated and protected by the legislature in such a manner, through such officers, and by means of such form of judicial process, as it might deem appropriate; and that every grant of the right to maintain a mill-dam across a stream where such fish are accustomed to pass is subject to the condition or limitation that a sufficient and reasonable way shall be allowed for the fish, unless cut off by express provision or obvious implications in the grant."

37.—STATISTICS OF THE FISHERIES OF THE UNITED STATES IN 1880.

[From the Compendium of the Tenth Census.]

The statistics of fisheries have been a blank, or, it would be more proper to say, a blotted page of the census reports, ever since those statistics were first sought to be obtained in 1850. It is questionable whether the results obtained ever reached 20 if indeed they ever reached 15 per cent. of the actual facts. The census of 1870 reported a total value of products of only $11,000,000, among the items being 647,312 bushels of oysters. Statistics like these were only calculated to bring the census into discredit, even when they did not have consequences of a more practical nature, as in the international arbitration of Halifax in 1877.

Under the provision of the act of March 3, 1879, the Superintendent, in June, completed arrangements with Professor Baird, Secretary of the Smithsonian Institution and president of the United States Fish Commission, by which the scientific direction of a comprehensive investigation into the statistics of the fisheries and the fishing populations of the United States should be assumed by himself, while the administrative charge of the service remained with the Census Office.

The details of the scheme having been arranged, a number of experts and skilled assistants, under the personal supervision of G. Brown Goode, were put into the field in the early summer.

Special canvassers, well trained for such inquiries, were engaged to proceed in vessels along the entire eastern and southern coast, from Maine to Texas, visiting every fishing port or fishing village, and collecting the whole body of social and industrial statistics of the populations engaged in this occupation, together with all facts of economic interest relating to the habits and the haunts of the various species of fish, the methods and apparatus employed, the labor systems in vogue, &c.

Other parties were engaged to canvass the Pacific coast, the northern lakes, and the western rivers, while special agents were engaged to work up the oyster fishery, and to obtain the statistics of the fish markets of the principal ports.

Some of these parties have now been four months in the field. The character of the reports already received puts the success of this investigation beyond a reasonable doubt. Already large bodies of material are being compiled and tabulated in this office. The work will be actively prosecuted through the winter and the coming summer, until every portion of the field shall have been covered.

Statistics of the fisheries of the United States in 1880.

	States and Territories.	Grand total.			Persons employed.		Apparatus and capital.		
							Vessels.		
		Persons employed.	Capital invested.	Value of products.	Fishermen.	Shoresmen.	Number.	Tonnage.	Value.
		No.	*Dollars.*	*Dollars.*	*No.*	*No.*			*Dollars.*
	The United States	131, 426	37, 955, 349	43, 046, 053	101, 684	29, 742	6, 605	208, 297. 82	9, 357, 282
	New England States	37, 043	19, 937, 607	14, 270, 393	29, 838	7, 205	2, 066	113, 602. 59	4, 562, 131
	Middle States, exclusive of Great Lake fisheries	14, 981	4, 426, 078	8, 676, 579	12, 584	2, 397	1, 210	23, 566. 93	1, 382, 000
	Southern Atlantic States	52, 418	8, 951, 722	9, 602, 737	38, 774	13, 644	3, 014	60, 886. 15	2, 375, 450
	Gulf States	5, 131	545, 584	1, 227, 544	4, 382	749	197	3, 009. 86	308, 051
	Pacific States and Territories	16, 803	2, 748, 383	7, 484, 750	11, 613	5, 190	56	5, 463. 42	546, 450
	Great Lakes	5, 050	1, 345, 975	1, 784, 050	4, 493	557	62	1, 768. 87	183, 200
1	Alabama	635	38, 200	119, 275	545	90	24	317. 20	14, 585
2	Alaska	6, 130	447, 000	2, 661, 640	6, 000	130	.....	.....	.....
3	California	3, 094	1, 139, 675	1, 860, 714	2, 089	1, 005	49	5, 246. 80	535, 350
4	Connecticut	3, 131	1, 421, 020	1, 456, 866	2, 585	546	291	9, 215. 95	514, 050
5	Delaware	1, 979	268, 231	997, 695	1, 662	317	69	1, 226. 00	51, 600
6	Florida	2, 480	406, 117	643, 227	2, 284	196	124	2, 152. 97	272, 645
7	Georgia	899	78, 770	119, 993	809	90	1	12. 00	450
8	Illinois	300	83. 400	60, 100	265	35	3	209. 73	8, 500
9	Indiana	52	29, 360	32, 740	45	7	1	21. 90	2, 500
10	Louisiana	1, 597	93, 621	392, 610	1, 300	297	49	529. 69	20, 821
11	Maine	11, 071	3, 375, 994	3, 614, 178	8, 110	2, 961	606	17, 632. 65	633, 542
12	Maryland	26, 008	6, 342, 443	5, 221, 715	15, 873	10, 135	1, 450	43, 500. 00	1, 750, 000
13	Massachusetts	20, 117	14, 334, 450	8, 141, 750	17, 16	2, 952	1, 054	83, 232. 17	3, 171, 189
14	Michigan	1, 781	442, 665	716, 170	1, 600	181	36	914. 42	98, 500
15	Minnesota	35	10, 160	5, 200	30	5	1	33. 59	5, 000
16	Mississippi	186	8, 800	22, 540	110	76	.....	.....	.....
17	New Hampshire	414	200, 465	176, 684	376	38	23	1, 019. 05	51, 500
18	New Jersey	6, 220	1, 492, 202	3, 176, 589	5, 659	561	590	10, 445. 90	545, 900
19	New York	7, 266	2, 629, 585	4, 380, 565	5, 650	1, 616	541	11, 582. 51	777, 600
20	North Carolina	5, 274	506, 561	845, 595	4, 729	545	95	1, 457. 90	39, 000
21	Ohio	1, 046	473, 800	518, 420	925	121	9	359. 51	38, 400
22	Oregon	6, 835	1, 131, 350	2, 781, 024	2, 795	4, 040	.....	.....	.....
23	Pennsylvania	552	119, 810	320, 050	511	41	11	321. 99	10, 500
24	Rhode Island	2, 310	596, 678	880, 915	1, 602	708	92	2, 502. 77	191, 850
25	South Carolina	1, 005	66, 275	212, 482	964	41	22	337. 32	15, 000
26	Texas	601	42, 400	128, 300	491	110	.....	.....	.....
27	Virginia	18, 864	1, 914, 119	3, 124, 444	16, 051	2, 813	1, 446	15, 578. 93	571, 000
28	Washington	744	30, 358	181, 372	729	15	7	216. 62	11, 100
29	Wisconsin	800	222, 840	253, 100	730	70	11	220. 25	26, 700

Statistics of the fisheries of the United States in 1880.

Apparatus and capital—cont'd.				Value of products by fisheries.							
Boats.		Value of minor apparatus and outfits.	Other capital, including shore property.	General fisheries.	Whale fishery.	Seal fishery.	Menhaden fishery.	Oyster fishery.	Sponge fishery.	Marine salt industry.	
Number.	Value.										
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dolls.*	*Dolls.*	
44, 804	2, 465, 893	8, 145, 261	17, 987, 413	22, 405, 018	3, 323, 943	2, 289, 813	2, 116, 787	13, 403, 852	200, 750	305, 890	
14, 787	739, 970	5, 038, 171	9, 597, 335	10, 014, 645	2, 121, 385	111, 851	539, 722	1, 478, 900	.....	3, 890	
8, 293	546, 647	674, 951	1, 822, 480	2, 882, 294	.....	.....	1, 261, 385	4, 532, 900	.....	.....	
13, 331	640, 508	1, 145, 878	4, 789, 886	2, 217, 797	408	.....	315, 680	7, 068, 852	.....	.....	
1, 252	50, 173	52, 823	134, 537	713, 594	.....	.....	.....	313, 200	200, 750	.....	
5, 547	404, 695	467, 238	1, 330, 000	4, 792, 638	202, 150	2, 177, 962	.....	10, 000	.....	302, 000	
1, 594	83, 400	766, 200	313, 175	1, 784, 050	.....	.....	.....	.....	.....	.....	
119	10, 215	7, 000	6, 400	74, 325	.....	.....	.....	44, 950	.....	.....	1
3, 000	60, 000	7, 000	380, 000	564, 640	500	2, 096, 500	.....	.....	.....	.....	2
853	91, 485	205, 840	307, 000	1, 341, 314	201, 650	15, 750	.....	.....	.....	302, 000	3
1, 173	73, 585	375, 535	457, 850	333, 887	32, 048	111, 851	256, 205	672, 875	.....	.....	4
839	32, 227	70, 324	113, 080	309, 029	.....	.....	941	687, 725	.....	.....	5
1, 058	28, 508	39, 927	65, 037	426, 527	.....	.....	.....	15, 950	200, 750	.....	6
358	15, 425	18, 445	45, 450	84, 993	.....	.....	.....	35, 000	.....	.....	7
101	2, 000	11, 900	61, 000	60, 100	.....	.....	.....	.....	.....	.....	8
15	1, 650	20, 210	5, 000	32, 740	.....	.....	.....	.....	.....	.....	9
165	4, 800	18, 000	50, 000	192, 610	.....	.....	.....	200, 000	.....	.....	10
5, 920	245, 624	934, 593	1, 562, 235	3, 576, 678	.....	.....	.....	37, 500	.....	.....	11
2, 825	186, 448	297, 145	4, 108, 850	479, 388	.....	.....	11, 851	4, 730, 476	.....	.....	12
6, 749	351, 7363.	528, 925	7, 282, 600	5, 581, 204	2, 089, 337	.....	61, 769	405, 550	.....	3, 890	13
454	10, 345	272, 920	60, 900	716, 170	.....	.....	.....	.....	.....	.....	14
10	900	3, 700	500	5, 200	.....	.....	.....	.....	.....	.....	15
58	4, 600	1, 600	2, 600	12, 540	.....	.....	.....	10, 000	.....	.....	16
211	7, 780	60, 385	89, 800	170, 634	.....	.....	.....	6, 050	.....	.....	17
4, 065	223, 963	232, 339	490, 000	949, 678	.....	.....	146, 286	2, 080, 625	.....	.....	18
3, 441	289, 885	190, 200	1, 171, 900	1, 689, 357	.....	.....	1, 114, 158	1, 577, 050	.....	.....	19
2, 714	123, 175	225, 436	118, 950	785, 287	408	.....	.....	60, 000	.....	.....	20
487	29, 830	253, 795	151, 775	518, 420	.....	.....	.....	.....	.....	.....	21
1, 360	246, 600	245, 750	639, 000	2, 776, 724	.....	4, 300	.....	.....	.....	.....	22
156	13, 272	40, 538	55, 500	132, 550	.....	.....	.....	187, 500	.....	.....	23
734	61, 245	138, 733	204, 850	302, 242	.....	.....	221, 748	356, 925	.....	.....	24
501	9, 790	25, 985	15, 500	192, 482	.....	.....	.....	20, 000	.....	.....	25
167	15, 000	4, 400	23, 000	81, 000	.....	.....	.....	47, 300	.....	.....	26
6, 618	292, 720	560, 763	489, 636	602, 239	.....	.....	303, 829	2, 218, 376	.....	.....	27
334	6, 610	8, 648	4, 000	109, 960	.....	61, 412	.....	10, 000	.....	.....	28
319	24, 975	145, 165	26, 000	253, 100	.....	.....	.....	.....	.....	.....	29

38.—PROPOSED EXPORTATION OF WHITEFISH EGGS TO SWITZERLAND.

By FRANK H. MASON,
United States Consul at Basle, Switzerland.

[From a letter to Prof. S. F. Baird.]

I am in receipt of your highly esteemed favor of December 28th, and beg to thank you very cordially for your very generous expression of willingness to contribute some whitefish eggs toward the very timely and valuable project of restocking the lakes of Switzerland. I have communicated your suggestion unofficially to several leading Swiss gentlemen, but the Government has as yet no facilities for hatching the eggs, and is only to a limited degree awakened or informed on this important subject. A gentleman of this city, Mr. Friedrich Gloser, jr., is an ardent fish culturist, and has facilities for making a good use of the eggs. If it is within your discretion to send 50,000 whitefish eggs to this consulate, I would have them delivered to Mr. Gloser, and see that they are properly used and yourself and the Government duly credited therefor. I believe that it would be a very happy and judicious courtesy to the Swiss people, and would be gratefully recognized.

BASLE, SWITZERLAND, *February* 28, 1883.

REPLY BY PROFESSOR BAIRD.

There will be no difficulty whatever in sending to Switzerland some eggs of American fish in their season. The application, however, should come officially from the Government or some of its branches, so as to have a proper diplomatic and international character. The American whitefish is very much the same as the *marane* of Switzerland, or *Coregonus marane.* Whether they would care to add this American variety to the list, it may be well to ascertain. It is too late now to make any transmissions. Applications received by September, can be filled for several varieties of *salmonidæ.*

WASHINGTON, D. C., *March* 13, 1883.

39.—FIRST APPEARANCE OF PORPOISE.

By CHAS. W. SMILEY.

Under date of February 28, 1883, Mr. Henry Y. Willets, keeper of Life-Saving Station No. 34, Townsend's Inlet, near Ocean View, New Jersey, reported as follows: "The first school of porpoise made their appearance this day at this place."

Vol. III, No. 18. Washington, D. C. Sept. 6, 1883.

40.—TONNAGE OF VESSELS OF THE UNITED STATES EMPLOYED IN THE WHALE, COD, AND MACKEREL FISHERIES, FROM 1860 TO 1882, INCLUSIVE.

By CHAS. W. SMILEY.

[From figures contained in the annual reports of the Register of the Treasury.]

Year ending June 30.—	Whale fisheries.	Cod fisheries.	Mackerel fisheries.	Total.
	Tons.	*Tons.*	*Tons.*	*Tons.*
1860	166, 841	136, 653	26, 111	329, 605
1861	145, 734	137, 846	54, 795	338, 375
1862	117, 714	133, 601	80, 596	331, 911
1863	99, 228	117, 290	51, 019	267, 537
1864	95, 145	103, 742	55, 499	254, 386
1865*	90, 516	65, 185	41, 209	196, 910
1866*	105, 170	51, 642	46, 589	203, 401
1867	52, 384	44, 567	31, 498	128, 449
1868	71, 343	83, 887		155, 230
1869	70, 202	62, 704		132, 906
1870	67, 954	91, 460		159, 414
1871	61, 490	92, 865		154, 355
1872	51, 608	97, 545		149, 155
1873	44, 755	109, 519		154, 274
1874	39, 108	78, 290		117, 398
1875	38, 229	80, 207		118, 436
1876	39, 116	87, 802		126, 918
1877	40, 593	91, 085		131, 678
1878	39, 700	86, 547		126, 247
1879	40, 028	79, 885		119, 913
1880	38, 408	77, 538		115, 946
1881	38, 551	76, 137		114, 688
1882	32, 802	77, 863		110, 665

* The tonnage for 1865 and 1866 is partly by new measurement and partly by old.

NOTE.—The mackerel licenses have not been issued separately since 1867, when a general fishing license was provided to replace cod and mackerel fisheries.

41.—STATISTICS OF THE IMPORTS AND EXPORTS OF FISH, FISH-OIL, WHALEBONE, ETC., FOR TEN YEARS ENDING JUNE 30, 1882.

By CHAS. W. SMILEY.

The following tables have been prepared from the annual reports of the Bureau of Statistics of the Treasury Department, and are based on the custom-house returns.

Attention may be called to the importation duty free of 109, 737, 420 pounds of fresh fish, valued at $3,242,566. Nearly all of this came from Canada under the treaty of Washington.

The exports have constantly increased in quantity and value, due doubtless in some degree to the successful participation of the United States in the international fishery exhibitions held in Europe.

I.—*Quantities of fish and oil imported into the United States during the ten years ending June 30, 1882.*

	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	Total.
I.—FREE OF DUTY.											
Fish, not of American fisheries:											
Fresh, of all kinds.....pounds..	8,636,279	9,587,595	15,308,769	10,723,216	7,735,981	9,681,828	8,432,835	10,761,307	12,975,761	15,893,849	109,737,420
Herring, pickled .....barrels..	.....	51,423	70,763	87,554	63,280	58,082	55,732	46,723	64,811	76,136	574,504
Mackerel, pickled.....barrels..	.....	89,503	77,479	76,531	43,066	102,148	101,420	112,468	120,288	58,279	781,182
Oils:											
Whale or fish, not of American fisheries.....gallons..	.....	165,448	277,739	103,184	138,708	311,091	182,625	407,416	568,660	337,076	2,491,947
II.—DUTIABLE.											
Fish, not of American fisheries:											
Herring.....barrels..	68,692	31,128	21,581	17,268	14,873	15,542	18,950	26,168	30,987	36,061	281,250
Mackerel .....barrels..	90,889	190	59	7	14	6	2	.....	9	164	91,340
Oils:											
Whale and fish, not of American fisheries .....gallons..	223,612	226,528	115,084	102,883	51,882	85,509	61,509	92,819	146,410	209,051	1,315,287

II.—Values of the fish and oil imported into the United States during the ten years ending June 30, 1882.

	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	Total.
I.—FREE OF DUTY.											
Fish, not of American fisheries:											
Fresh, of all kinds	$278,921	$294,837	$351,889	$271,597	$236,098	$339,561	$283,827	$320,403	$376,508	$488,925	$3,242,566
Herring, pickled	(a)	181,521	288,590	306,555	210,786	230,533	192,069	154,003	236,403	265,797	2,066,257
Mackerel, pickled	(a)	800,920	584,283	695,412	372,260	907,246	649,721	493,059	614,729	396,149	5,513,779
All other not elsewhere specified	(b)	553,949	928,344	501,154	581,592	637,437	763,915	912,336	1,088,336	1,366,963	7,334,026
Oils:											
Whale or fish, not of American fisheries	(b)	91,944	161,289	62,438	84,088	176,384	80,701	170,525	293,600	158,878	1,279,847
Total	278,921	1,923,171	2,314,395	1,837,156	1,484,824	2,291,161	1,970,233	2,050,326	2,609,576	2,676,712	19,436,475
II.—DUTIABLE.											
Fish, not of American fisheries:											
Herring, pickled	359,262	253,044	226,494	186,535	189,615	180,840	189,204	288,407	290,073	375,617	2,539,091
Mackerel, pickled	610,457	1,550	553	48	148	67	14	.....	97	1,179	614,113
Sardines and anchovies preserved in oil or otherwise	1,172,704	991,030	526,179	595,901	773,331	677,910	912,391	1,102,410	987,394	860,760	8,600,010
All other not elsewhere specified	663,913	131,676	102,283	96,046	91,654	149,852	118,050	132,684	142,158	294,606	1,922,922
Oils:											
Whale and fish, not of American fisheries	106,294	121,927	70,404	63,286	44,015	56,616	45,903	55,133	82,584	103,020	749,182
Total	2,912,630	1,499,227	925,913	941,816	1,098,763	1,065,285	1,265,562	1,578,634	1,502,306	1,635,182	14,425,318

a Included in dutiable, "Fish, other." *b* Included in dutiable, same class.

III.—Quantities of fish, oils, spermaceti, and whalebone exported from the United States during the ten years ending June 30, 1882.

	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	Total.
Fish:											
Dried or smoked ... cwts.	118,076	129,982	129,752	175,528	159,648	188,831	179,130	197,450	212,691	159,512	1,650,600
Pickled ... barrels.	16,747	29,000	51,025	54,291	76,227	57,554	47,764	54,345	52,092	38,224	477,269
Oils:											
Whale and other fish ... gallons	288,263	573,775	895,907	1,067,515	1,026,038	904,988	2,236,265	1,022,889	597,812	1,083,925	9,697,377
Sperm	756,306	529,903	491,130	892,762	634,991	723,398	812,928	482,153	314,568	540,064	6,178,203
Spermaceti ... pounds.	197,671	304,865	238,641	141,157	153,552	228,276	147,503	197,847	214,205	265,593	2,089,310
Whalebone ... pounds.	324,653	114,530	251,572	154,500	71,708	154,016	78,322	131,332	227,117	220,787	1,728,537

IV.—*Values of fish, oils, spermaceti, and whalebone exported from the United States during the ten years ending June* 30, 1882.

	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	Total.
Fish:											
Fresh	$64,577	$56,974	$69,448	$80,879	$114,338	$84,278	$80,437	$124,962	$97,539	$89,148	$862,580
Dried and smoked	569,151	612,589	710,121	900,306	791,785	766,154	748,747	739,231	840,199	635,155	7,313,438
Pickled	109,201	226,041	359,669	417,281	486,738	416,162	290,862	284,293	264,723	244,454	3,099,424
Other cured	677,171	1,128,208	1,855,550	2,102,522	2,486,225	3,198,896	2,939,587	2,326,444	2,803,330	3,218,581	22,736,514
Oils:											
Whale and other fish	154,243	280,750	413,411	436,072	442,165	411,808	756,248	349,109	229,726	420,730	3,894,262
Sperm	1,095,831	827,991	847,014	1,366,246	879,865	801,218	719,831	487,004	303,113	551,212	7,879,325
Spermaceti	55,815	78,346	61,725	35,915	41,027	58,302	35,489	45,018	40,945	48,721	501,303
Whalebone	329,214	115,098	291,165	215,327	160,666	264,980	199,753	255,847	326,400	325,333	2,483,783
Total	3,055,203	3,325,997	4,608,103	5,554,548	5,402,809	6,001,798	5,770,954	4,611,908	4,905,975	5,533,334	48,770,629

V.—*Quantities of foreign fish and oils exported from the United States during the ten years ending June* 30, 1882.

	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	Total.
I.—Free of duty.											
Fish, not of American fisheries:											
Fresh, of all kinds ..... pounds	.....	.....	66,728	.....	.....	.....	.....	.....	.....	.....	66,728
Herring, pickled ..... barrels	(a).	233	2,318	2,885	1,903	21	.....	.....	624	101	8,085
Mackerel, pickled ..... barrels	(a).	35	1,300	885	.....	356	171	272	842	60	3,921
Oils:											
Whale or fish, not of American fisheries ..... gallons	(a).	.....	.....	.....	43,103	379,570	.....	.....	880	10,794	434,347
II.—Dutiable.											
Fish, not of American fisheries:											
Herring ..... barrels	19,928	4,271	43	.....	2	.....	.....	.....	.....	.....	24,244
Mackerel ..... barrels	36,146	5,334	.....	.....	.....	.....	.....	.....	.....	.....	41,480
Oils:											
Whale or fish, not of American fisheries ..... gallons	35,016	73,429	29,246	52,736	1,705	8,800	5,245	602	7,939	11,580	[illegible]8

a. Included in dutiable, same class.

VI.—Values of foreign fish and oil exported from the United States during the ten years ending June 30, 1882.

	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	Total.
I.—FREE OF DUTY.											
Fish, not of American fisheries:											
Fresh, of all kinds	.....	.....	$3,895	.....	.....	.....	.....	.....	.....	.....	$3,895
Herring, pickled	(a).	$1,157	11,576	$13,305	$9,088	$71	.....	.....	$1,770	$381	37,348
Mackerel, pickled	(a).	358	10,254	4,515	.....	2,279	$684	$1,260	3,889	360	23,599
All other not elsewhere specified	(a).	29,411	133,620	39,618	32,120	76,144	206,440	188,265	59,501	53,644	818,763
Oils:											
Whale or fish, not of American fisheries	(a).	.....	.....	.....	26,669	217,562	.....	.....	475	4,715	249,421
Total	.....	30,926	159,345	57,438	67,877	296,056	207,124	189,525	65,635	59,100	1,133,026
II.—DUTIABLE.											
Fish, not of American fisheries:											
Herring, pickled	$81,775	16,650	146	.....	22	.....	.....	.....	.....	.....	98,593
Mackerel, pickled	178,328	29,429	.....	.....	.....	.....	.....	.....	.....	.....	207,757
Sardines and anchovies preserved in oil or otherwise	45,452	59,796	23,296	19,667	24,780	30,455	29,149	36,000	45,839	47,833	362,267
All other not elsewhere specified	213,534	35,803	23,433	55,905	135,854	116,266	54,954	13,632	69,063	212,620	931,064
Oils:											
Whale or fish, not of American fisheries	25,601	34,196	11,246	20,842	794	8,058	2,363	331	3,334	8,848	115.243
Total	544,690	175,874	58,111	96,054	161,450	154,779	86,466	49,963	118,236	269,301	1,714,924

a. Included in dutiable, same class.

42.—REPORT ON THE TRAP-NETS FISHED IN THE SPRING OF 1883 IN THE POTOMAC RIVER AND CHESAPEAKE BAY.*

By Lieut. W. M. WOOD, U. S. N.

[From letter to Prof. S. F. Baird.]

I beg leave to submit the following report on the trap-nets fished this season in the Potomac River from Bryant's Point to its mouth, and in the Chesapeake Bay from the mouth of the Potomac, by way of the Capes, to Cherrystone Inlet. The accompanying table gives whatever reliable data I have been able to obtain.

Wherever possible the catch of shad and herring was obtained, but in most instances the owners of the nets were not to be found, and in many others they had no record of the catch themselves.

The fishermen of the Potomac spoke of the catch this season as very light, but the reports became more favorable as we came down the bay, culminating at York Spit, where it was the best ever known. The catch here exceeded that of last year by one-third, and the average per net was from 10,000 to 25,000 shad, and immense numbers of herring of which no account was kept. The fishermen on the Eastern Shore say they never make very large catches of shad there; that they did fairly this year, and considerably better than last season. The table shows 153 nets in the Potomac, 244 on the west side of the bay, and 15 on the Eastern Shore, making 412 in all.

In some localities, instead of calling a net of two or more pockets a single net, the fishermen speak of it as so many separate nets of a single pocket each.

In some instances, these nets, in a line, one outside the other, belong to different individuals, though to all appearances they are one net. Whenever I was able to find out a net which had more than one pocket it has been so specified.

Owing to the lateness of the season some few nets have probably escaped my observation. After the shad season, most of the nets are taken up, even as far down as York Spit. Comparatively few fish for mackerel and summer fish.

STEAMER FISH HAWK,
York River, June 21, 1883.

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* The accompanying tables have been compiled in the office of the Fish Commission from the more detailed tables furnished by Lieutenant Wood.—EDITOR.

Shad and herring nets in the Potomac River, 1883.

Name of shore.	Number of firms engaged in fishing.	Number of nets.	Length of nets in fathoms.	Number of pockets in each.	Season's catch.	
					Shad.	Herring.
POTOMAC RIVER.						
Gut Landing	1	4	600	1	300	15,000
Gunnison Cove	1	6	(a)	1	.....	.....
Indian Head	3	6	600	1	.....	.....
Occoquan Flats	1	2	400	1	.....	.....
Deep Point	1	2	200	1	300	20,000
Stump Neck	.....	2	.....	1	.....	.....
Goose Bay	1	2	300	1	.....	.....
Liverpool Point and Sandy Point	1	3	.....	1	.....	.....
Nanjemoy Reach	2	4	400	1	(b)	(b)
Upper Cedar Point	1	4	600	1	.....	.....
Port Tobacco Flat	2	8	1,025	1	(c)	(c)
Mathias Point	1	2	300	1	(b)	(b)
Pope's Creek	3	12	1,450	1	(d)	(d)
Mouth of Port Tobacco Creek	1	2	300	1	.....	.....
Prospect Hill	1	3	300	1	.....	.....
Clifton	1	2	200	1	.....	.....
Persimmon Point	1	3	300	1	.....	.....
Lower Cedar Point	1	2	300	1	500	100,000
Mouth of Machodic Creek	1	4	(e)	(e)	(e)	(e)
Picawaxen Creek	2	3	(f)	1	(b)	(b)
Machodic Flats	1	2	200	1	.....	.....
Cedar Island	3	7	700	1	.....	.....
Rozier's Creek	4	14	1,400	1	.....	.....
Bluff Point	1	5	500	1	3,000	175,000
Hollister's	1	1	100	1	(g)	(g)
White Point	1	5	500	1	.....	.....
Mattox's Creek	2	6	600	1	.....	.....
Bridge's Creek	1	2	200	1	.....	.....
Stratford Mills	1	1	75	1	.....	.....
Curioman	1	3	300	1	.....	.....
Ragged Point	1	5	500	1	.....	.....
Mouth of Neal's Creek	1	2	300	1	.....	.....
Henry Creek	1	1	100	1	.....	.....
Saint George Island Bar	3	3	.....	.....	.....	.....
Cornfield Harbor	1	1	.....	.....	.....	.....
Sandy Point, mouth of Yeomico River	1	2	.....	.....	.....	.....
Lynch's Point, mouth of Yeomico River	3	3	(h)	1	(i)	(i)
Hog Island, mouth of Coan River	6	11	1,100	1	(j)	(j)
Great Neck, Coan River	2	2	200	1	2,500	35,000
Mouth of Cubitt's Creek	1	1	100	1	1,500	20,000

(a) Two of the six pound-nets at Gunnison Cove measured 100 fathoms apiece.

(b) Catch small.

(c) The catch for three of the eight pound-nets at Port Tobacco consisted of 500 shad and 100,000 herring; that for the rest is not reported.

(d) The catch for four of the twelve pound-nets at Pope's Creek consisted of 400 shad and 15,000 herring; that for five of the remainder is said to have been small, and nothing has been ascertained regarding that for the other three.

(e) Two of the four pound-nets at Machodic Creek measured 100 fathoms each and contained one pocket apiece. Their catch consisted of 500 shad and 20,000 herring; that for the others is not reported.

(f) One of the three pound-nets at Picawaxen Creek was 125 fathoms long.

(g) Catch fair.

(h) Two of the three pound-nets at Lynch's Point measured 100 fathoms each.

(i) The catch for one of the three pound-nets at Lynch's Point consisted of 400 shad and a very few herring; that of one is reported small, and that of the third is unknown.

(j) The catch of nine of the eleven pound-nets at Hog Island consisted of 8,000 shad and 90,000 herring; that of the other two was slight.

Shad and herring nets in Chesapeake Bay, 1883.

Name of shore.	Number of firms engaged in fishing.	Number of nets.	Length of nets in fathoms.	Number of pockets in each.	Season's catch.	
					Shad.	Herring.
WEST SHORE OF CHESAPEAKE BAY.						
South of Smith's Point	1	1	300	3	(*a*)	(*a*)
Taskmaster's Creek	25	38	(*b*)	1	(*b*)	(*b*)
Dammeron's Marsh	3	4	.....	1	(*c*)	(*c*)
Between North Point and Windmill Point	1	2	.....	1	(*c*)	(*c*)
Mouth of Rappahannock River	7	11	.....	1	(*c*)	(*c*)
Inside of Rappahannock Spit	16	30	.....	1	(*c*)	(*c*)
South side of Rappahannock Entrance	5	9	.....	5	(*c*)	(*c*)
Hill's Bay, mouth of Piancatank River	4	6	.....	1	(*c*)	(*c*)
South Shore	2	3	.....	1	(*c*)	(*c*)
Gwynn's Island	7	16	.....	1	(*d*)	(*d*)
Mobjack Bay	21	21	.....	1	(*e*)	(*e*)
Wolf-Trap Spit	1	5	.....	1	(*f a*)	(*f a*)
Dias Creek Bar	11	17	.....	1	(*f a*)	(*f a*)
York Spit	21	62	.....	1	(*f a*)	(*f a*)
York Spit and Too's Point	11	19	.....	1	(*f a*)	(*f a*)
EAST SHORE OF CHESAPEAKE BAY.						
Cape Charles	6	6	.....	1	(*g*)	(*g*)
Picket's Hole	5	9	.....	1	(*h*)	(*h*)
Total	.....	412	.....	.....	.....	.....

(*a*) Catch large.

(*b*) Three of the thirty-eight pound-nets at Taskmaster's Creek measured 100 fathoms each. Their catch consisted of 3,500 shad and 95,000 herring; that for twenty-three was of fair size, and that for the other twelve was very slight.

(*c*) Catch fair.

(*d*). The catch for fourteen of the sixteen pound-nets at Gwynn's Island consisted of 21,000 shad and 950,000 herring; that for the other two is not known.

(*e*) Four of the twenty-one pound-nets at Mobjack Bay contained one pocket, fourteen contained two pockets, and three contained three pockets. The catch for one pound-net was fair, that for three was light, and that for the remainder was not reported.

(*f*) The best season ever known, the nets averaging from 10,000 to 25,000 shad each, together with great quantities of herring of which no record was kept. The catch was one-third larger than that of last year, and greatly exceeded any catch made during the previous eight years.

(*g*) Two of the six pound-nets at Cape Charles measured 100 fathoms each. Their catch consisted of 1,000 shad and 10,000 herring; that for the others was fair, and better than last year.

(*h*) Catch fair and better than last year.

43.—EARLY CATCH OF MACKEREL.

By BARNET PHILLIPS.

[From letter to S. F. Baird.]

Mackerel in market to-day caught on Thursday [March 29] off Hatteras. In 1882 they were in New York markets on the 1st of April; in 1881 on the 23d of March.

TIMES OFFICE, NEW YORK, *March* 31, 1883.

14.—REARING OYSTERS FROM ARTIFICIALLY FERTILIZED EGGS, TOGETHER WITH NOTES ON POND-CULTURE, &c.

By JOHN A. RYDER.

The desirability of testing the breeding of oysters in ponds in the United States, as practiced for many years past in France, has long been a desideratum.

In order to test the feasibility of such a method on a scale large enough to give us practical results, an arrangement to carry out such a scheme was finally effected with the Eastern Shore Oyster Company in June of the present year. The beds near where the work was undertaken are owned by Messrs. Pierce & Shepard, who afforded the writer every opportunity to carry on his investigations, and also aided him very materially in the work of experiment. A pond was excavated in the salt marsh on the shore of Chincoteague Bay, on a farm situated at a distance of about 2 miles from the village of Stockton, Worcester County, Maryland. This pond covered an area of about 50 square yards, and was connected with the bay by a trench or canal about 10 feet in length, 2 feet in width, and 3½ feet in depth, which last was the same as that of the pond itself.

The water which supplies this pond was filtered through a permeable, porous gate, or diaphragm, which was placed in the trench connecting the pond with the bay, and no water was allowed to enter the pond which had not been first filtered through this diaphragm.

The diaphragm itself was constructed of boards perforated with auger holes, and lined on the inside with gunny-cloth or sacking; and the space between the perforated boards filled with sharp, clean sand. The space between the boards was about 2 inches; through this the tide ebbed and flowed, giving a rise and fall of from 4 to 6 inches during the interval between successive tides.

This apparatus, if it may be called such, constituted the receptacle into which the artificially fertilized eggs of a number of oysters were introduced every two or three days.

It was supposed, when the experiment was commenced, that some difficulty would be experienced with a rise of temperature in the pond in excess of that found in the bay, because the water was kept confined and still, and constantly exposed to the direct rays of the mid-day sun. But to our surprise and gratification it was learned that the temperature in the pond and in the bay was precisely the same at every observation which was made in order to test this question.

Another question also arose in our minds as to whether it might not be that the water in the pond might become less salt than that in the open bay; in other words, that its specific gravity would be less than that of the water in the bay, owing to leeching from the banks of the pond in addition to that precipitated during rains.

To our great satisfaction we were also agreeably disappointed to find that the specific gravity of the water in the pond remained steadily about the same as that found to prevail in the bay. The specific gravity in the pond was 1.018, and 1.020 at times in the bay, to as low as 1.0175, and the fluctuation of the specific gravity of the water in the pond was found to be about the same as in the bay.

At the head of the creek the specific gravity of the water was about 1.010. In this situation a good many oysters were living and growing; but even this density is not so low as that prevalent in the waters of Saint Jerome's Creek, where it fluctuates between 1.007 and 1.010, and where excellent oysters are grown.

From numerous observations and considerations based upon the facts of distribution, it is believed that the oyster in all cases thrives best in waters of a specific gravity about such as has been indicated above, or from 1.007 to 1.020.

Another equally important point to settle was whether a sufficient amount of food would be generated in the pond to supply any young or old oysters with nourishment. To our satisfaction we found immediately after the diaphragm had been placed in the trench that the confined waters of the pond acquired a distinctly brownish-green tint, which we at first supposed was due to particles of dead, brown organic matter. A microscopical investigation of the water showed that in this we were in error, and that the brown color of the water was largely due to the presence of innumerable microscopical plants, consisting largely of diatoms, having brownish contents. It was also found that immense multitudes of very small monads, with long flagella, would collect upon floating chips and light objects at the surface of the water during the warm mid-day hours. It seems, therefore, evident that food was generated in abundance here, and greatly in excess of what may be found in the open bay, and that one of the most important conditions for the success of our experiment had been established.

The final results fully confirmed this conclusion, inasmuch as we found that spat grew just as rapidly in the pond as in the waters of the open bay. There is, moreover, no reason to suppose that it would not grow to a marketable size just as certainly as spat collected in the natural way.

COLLECTORS.

The collectors used in our experiment were of the simplest possible character, the object being to make the experiment as practical in character as possible. To this end stakes were driven into the bottom of the pond, extending above the surface some distance, to which oyster shells, with holes punched through, were attached after being strung upon galvanized iron wire. A number of these simple collectors were placed in the pond, each set being marked with the date on which they were placed in position, in order to afford data for a more detailed study of the results of the experiment.

The first collectors of the kind described were placed in position upon the same day when the first spawn was poured into the pond. This occurred on the 7th of July last.

Other collectors were then put down at odd dates during the remainder of the month of July. The care of this portion of the experiment, together with the spawning of the oysters themselves, was mostly in the hands of Mr. H. H. Pierce, whose share in the work was, to say the least, as important as my own.

METHODS OF TAKING AND INTRODUCING THE SPAWN INTO THE POND.

The oysters used for the purpose of spawning were taken from the vicinity of the oyster-house, which stood only about twenty yards from the pond, besides others which were obtained from the deeper waters of the adjacent bay. It was found that the eggs of those from the shallow water near the pond were as readily fertilized as those from the deeper water, and no difficulty was experienced at any time until towards the latter part of July in obtaining an abundance of good spawn for our experiments.

The oysters from which spawn was obtained were carefully opened by removing the right valve and allowing the soft parts of the animal to remain attached by the muscle to the left one. The spawn itself was then pressed out of the generative organs by means of a pipette gently stroked over the gland and out along the course of the efferent ducts, so as to force the spawn out into the upper gill chamber, as described in previous publications by the writer.

The sexes were distinguished apart very easily by what the writer has described as the "drop test," which consists simply in dropping the spawn from a pipette into a dish of clean sea-water and watching the kind of cloud which it forms after it strikes the water. Invariably, if the specimen was a female, the eggs would break up into a granular cloud which could be very readily seen to be composed of very minute whitish bodies if the transparent vessel was held up so as to look down through it upon a dark ground below.

In case the specimen was a male the drop of milt would not so readily break up, but would exhibit a somewhat glairy consistency; and if the drop was stirred in the water it would break up into wisps and streaks, so as to appear, on a small scale, like a series of minute mare's tail clouds such as are seen in the sky at times. This test was found so practicable that we were able to readily teach a novice how to distinguish the sexes apart in one lesson.

The method of taking the spawn was just as easily learned by Mr. Pierce and Mr. Shepard, both of whom soon became as expert as the writer in the practice of the art of taking oyster spawn. The spawn so taken was mixed together in a small dish. The milt and eggs placed in contact at once were thoroughly stirred together and poured from time to time, as the water became milky in the small glass collecting

vessel, into a wooden pail. This was repeated until it was believed that a sufficient amount of spawn was mixed with the water in the pail, which was then taken and poured into the pond at different points, in order to distribute it over as great an area as possible.

Before the spawn was poured into the pond, however, it was allowed to stand in the pail from three to five hours, in order to give it a chance to develop to the swimming stage of the embryo. Fresh supplies of water were also added once or twice during this time to that in the pail in which the spawn was originally taken.

This briefly describes the processes used in conducting our experiment; and while it bears a strong resemblance to the method used by Mr. Brandely, it is really very different in that he had a second pond at a higher level from which supplies of fresh water were drawn through a sponge filter. In our case nothing of the kind was used; we depended absolutely upon nothing else than the rise and fall of the tide for the renewal of the water in the pond. We did, however, use a diaphragm through which the water could pass and repass somewhat similar to that used by the French experimenter. The method used at Stockton was, however, essentially the same as the apparatus devised by the writer in 1880 and 1881, but which was designed and made on such a small scale and under such unfavorable conditions that no practical results were achieved.

RESULTS OF THE EXPERIMENT.

On the 22d day of August, or 46 days after the beginning of our experiment, Mr. Pierce sent me by mail a series of shells taken from the collectors, which had been placed in the pond at various dates during the month of July, and which showed young oysters or spat attached, ranging from one-fourth to three-fourths of an inch in diameter; demonstrating conclusively that the young would grow just as rapidly in our pond as in the waters of the open bay. Of this last fact I am positively assured on the ground of previous observations made during the three preceding seasons.

We are therefore prepared to assert that it is perfectly feasible to rear oysters from artificially fertilized eggs, and, so far as I can judge, quite as successfully as by the method of sowing shells on the bottom, now largely practiced on the coast of Connecticut in the waters of Long Island Sound. While our experiment has not shown that we could get a greater set of spat than that ordinarily obtained under natural conditions on planted shells, the experiment has settled several questions which are of the greatest importance in the practical work of oyster culture.

One of the difficulties encountered was the same as that met with in shell-planting in the open waters, namely, the accumulation of slime and ooze on the surface of the collectors, which is so deadly to the infant oyster when it is from one five-hundredth to one-ninetieth of an inch in diameter, a very slight quantity of sediment serving at this

time to smother the infant mollusk and arrest the flow of water through its tiny gills. thus producing death by asphyxia.

THE FOOD OF YOUNG OYSTERS.

This slime I have determined, during the previous seasons, to be largely composed of the very lowest vegetable organisms, namely, *bacteria*, or those plants constantly associated with putrefactive processes, and even accused of being the proximate or remote causes of contagious and infectious diseases in man and the lower animals.

Any one, however, who has carefully studied the feeding habits of the young oyster is soon convinced that it is upon these very low and minute forms that the animal largely depends for food. In fact, it is possible to frequently find young oysters in the stomachs of which multitudes of these minute plants are rotating under the impulse of the vibratile cilia with which the stomach is lined, the stomach itself being a cavity not over the one four-thousandth of an inch in diameter, which will give some idea of the minuteness of the food required to nourish so tiny a creature.

It appears that in practice it will be impossible for us ever to provide against the generation of minute organisms which form the slimy coating of fixed objects used as collectors in the water. But from the foregoing considerations it would appear that the removal of the slime, or the prevention of its deposit, is not altogether desirable, in view of the fact that the minute plants comprising a large part of it form an important element in the development of the young, serving, as we have seen, to nourish it during its infant life.

UTILITY OF THE EXPERIMENT.

The practical utility of the experiment, in the writer's estimation, consists in this, that it proves that ponds or inclosed areas of water may be readily utilized on the eastern coast of the United States for cultivating oysters in the same way as is practiced in France and other foreign countries. In fact there are many thousands of acres of salt marsh all along the eastern coasts of the States of Virginia, Maryland, Delaware, New Jersey, and perhaps New York, and Chesapeake, Delaware, and Chincoteague Bays, which could be readily converted into permanent and profitable planting grounds for the cultivation of oysters.

The great advantage of this method would be that the persons, constructing the inclosures or digging out ponds on their own territory, would be absolutely protected by law from the incursions of the lawless tongers whose rights and privileges are not yet as clearly defined in some of the States as they should be. The method would also be of advantage from the fact that inclosed areas properly constructed are more accessible—in fact, could be so arranged as to be worked without the use of boats. It would also be found that oysters would fatten and come into condition for market at a relatively much earlier time in the

season than those planted in open, unconfined waters where cold currents interfere with the abundant development of food.

This view is borne out by the fact that green-gilled oysters are invariably fat, and are usually found at the end of summer in more or less confined waters, or under such conditions as would obtain in inclosed areas in some degree similar to the one used in our experiment at Stockton. In truth, the writer is now confirmed in the belief that the green-gilled condition is due to an abundance of green microscopic food, which is absorbed in large quantities so as to tint the juices and finally the blood-cells of the animal, and that these green organisms are multiplied under just the conditions afforded by more or less completely inclosed ponds or areas of brackish water.

THE BEST COLLECTORS FOR MUDDY WATER.

The collectors best adapted for waters which contain a large amount of organic matter in suspension are evidently brush or stakes supporting strings of oyster shells strung on wire, because the tide will constantly tend to sweep the accumulated sediment off the surfaces of the twigs and shells. Such collectors should of course be put into the water upright, so as to cause the collecting surfaces to be far above the bottom, which is usually covered to a depth of from a few inches to several feet with black ooze or mud in such situations. The brush should be thrust with the main stem down into the mud far enough to support the branched top against the tide, and also be so placed as to bring the top below low water. The stakes, with their load of shells, should be arranged in a similar way.

These two forms of collectors seem to me to be the cheapest and most available in the practical work of spat collecting where the water contains much sediment and the bottom is too deeply covered with ooze to make shell planting profitable. Where the ooze is too deep shells will rapidly sink into it so as to be entirely covered, and afford no surface to which young spat can attach itself and grow.

By means of some such method a large area can be rendered profitable as planting ground which is now utterly barren and useless for such purposes.

These are mere suggestions, but I am fully convinced from the facts which have come under my observation during the last three years that they are very important ones, because in many cases it is evident that all that is needed to get spat is to afford surfaces upon which it may attach itself in those situations where the bottom is deeply covered with mud and where the fixation of spat and the establishment of oyster-beds is often, without such provision, a sheer impossibility. The importance of placing collectors in such places must, therefore, be evident to the intelligence of the most ordinary person.

OBSERVATIONS UPON OYSTER SPAT AT WOODS HOLL, MASS.

In the early part of the month of August my attention was called to a number of wooden buoys lying on the beach near the light-house establishment at Woods Holl, and which had been taken from the upper end of Buzzard's Bay, near Cohasset. These wooden buoys were replaced by others during the early part of July. Upon examining the surfaces of a number of those which had been removed from their former position, it was found that they were covered with a remarkable "set" of young oysters ranging in size from one-ninetieth to one-eighth of an inch. In some cases as many as twenty-five young oysters might have been counted on a surface of one square inch. Every available clean surface was covered more thickly than I had ever observed anywhere in either the Chesapeake or Chincoteague Bays. It was evident that the attachment of spat in this case would have been very great in that vicinity had there been an abundance of collectors placed in position in the early part of the month of July or the latter end of June, the time which seems to be the most important period at which to place collecting apparatus in position, as shown by my observations in Chincoteague Bay, where I am satisfied that little or no spat caught on any sort of collecting apparatus previous to the 1st of July, although oysters in the vicinity may have been spawning much earlier.

This point was determined by the following method: Upon examining the shells and old oysters in Chincoteague Bay, about the end of June, I soon became convinced that all the young oysters then visible belonged to the set of last season. Two facts served to prove this; the first was that the larval shell was eroded or eaten off of the beaks of the spat shells by the carbonic acid in solution in the water. It was also evident that these young oysters had made a second growth which belonged to this year, because a distinct offset or line indicating as much could be detected on the outside of the upper valve of every specimen which was examined. These data serve to finally fix the approximate time at which the set of spat occurs in the latitude of Chincoteague Bay. But it is evident that this time is somewhat later in Buzzard's Bay, on the coast of Massachusetts, from the fact that the spat observed in that neighborhood averaged much smaller than that from the more southern waters alluded to above.

THE SET OF SPAT IN BUZZARD'S BAY.

During the second week of August, in company with Vinal N. Edwards, I made a trip on the steam-launch from Woods Holl to the head of Buzzard's Bay to examine the set of spat in that region, having been encouraged to do so by what I had witnessed on the buoys brought in from the neighborhood some weeks before. Going to a point of land covered largely by coarse gravel, we found that a planter had sown a considerable area with clam and oyster shells. It was ascertained that

immense numbers of spat had been caught, ranging from about one sixteenth to three-eighths of an inch in diameter; the average size was probably about three-sixteenths of an inch. In some cases a single shell was found to give attachment to more than 100 young oysters of the sizes mentioned.

It is evident, of course, that a large proportion of these, owing to their being so crowded, could not possibly survive much beyond the time when they would grow large enough to crowd each other and come in contact at their edges. Many would necessarily be killed in the course of growth from this cause, so that it follows that it is not desirable that spat should catch so thickly as in this case. Indeed it is probable that a set of three to five young oysters on one shell has a better chance to survive than a much larger number. But the question here raised can only be settled by future observations made by competent persons, though it is true that the author has made some observations which afford almost positive proof that young oysters are sometimes killed by overcrowding while still quite small.

THE SET OF SPAT IN 1883 IN DIFFERENT OTHER LOCALITIES.

The set of spat on planted shells, and on all kinds of objects in the water, seems to have been unusually large during the past summer. Reports from various sources indicate as much; since it is a fact that shells planted in Buzzard's Bay, as noted above, have had in some places an unusual crop of young oysters fixed to them.

In Long Island Sound the planted oyster shells have had an enormous number of spat attached, as is shown by a report in the *Hartford Times.*

The shells in the vicinity of New Haven, according to this report, cost seven cents per bushel. The firm of the Smith Brothers, who, by the way, sold $30,000 worth of oysters last year, have sown 130,000 bushels of shells on their 350 acres of oyster farm land this year, at a cost of about $17,000. The set upon their shells is an unusually large one, and has caused considerable excitement amongst the oyster-men in the vicinity.

The Smith Brothers tried only four of their beds. One of these was sown with shells by a younger brother last spring, who put his mite of $500 into the work. His lot seemed to be the most thickly covered with spat; and one of the firm offered him $3,000 in hard cash for it, but he declined the proffer with thanks.

In Chincoteague Bay Messrs. Pierce & Shepard have also sown some ground with shells this season. The result has been most gratifying, in that a very good set has been found on them.

In the southern waters, especially in Chesapeake Bay, the sowing of shells has not been practiced to the extent that it probably will be in the course of the next few years, when the method is more favorably known.

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One advantage of oyster culture in the Chesapeake over that practiced in Long Island Sound and the more northern waters is, I believe, to be noted in the fact that star-fishes are not as abundant; nor have I ever heard that they were as destructive as they are farther north. The experience of Messrs. Pierce & Shepard proves conclusively that what applies to the practice of shell-planting in Long Island Sound is equally applicable in the waters of Chincoteague Bay, and, inferentially, in those of the Chesapeake.

ENEMIES.

There are some "drills," or boring whelks, which are found in Chincoteague Bay, that bore into the shells of living oysters and cause some destruction, but not, so far as I could learn, to a serious extent.

These molluscan enemies of the oyster are found more or less abundantly in all waters in which oyster culture is practiced; and are probably one of the necessary evils to be encountered in the business, together with the boring sponge, which eats into the shells and which seems to be found in greater or less abundance wherever oysters grow.

PROPER CONDITIONS.

The idea that a rough, ragged surface is necessary upon which oyster fry may readily catch, is a fallacy. The prime condition that is necessary in order that the fry may adhere, and live, to any surface put down for collecting purposes, is that that surface shall be clean and remain so long enough for the young oyster to get large enough to take care of itself in some measure.

It is doubtless true that where oyster shells are pretty thickly sown, the interstices between the shells serve to some extent to retain the fry whilst they are still in the swimming stage; but rough surfaces are not at all essential, in that we find spat sets as thickly on the smooth inner surface of oyster shells as upon the rough outer one.

METAMORPHOSIS OF THE FRY.

When the young oyster ceases to swim, and attaches itself, it undoubtedly grows considerably after the time of attachment before its valves lose the perfect symmetry of the larval stage. This has been proved by the examinations which I have made of the spat caught on the buoys brought to Wood's Holl. This is also evidence that the writer is probably correct in his statement that the young oyster attaches very soon, or within 24 to 48 hours after the eggs have been fertilized, as announced in his paper on the "Fixation of the fry of the oyster," published in Bulletin United States Fish Commission, vol. 2, 1882, pp. 383 to 387. Another fact confirming this opinion is the circumstance that it

is impossible to start the larval shell of the oyster from its surface of attachment, after it has acquired the umbones and before it begins to develop the spat shell, without breaking it. This is proof that the shell of the fry has been glued to its surface of attachment at a very early stage; and it is also a fact that it is invariably the left valve which is undermost with its beaks directed towards the left side.

COMPARATIVE FREEDOM OF THE WATER FROM SUSPENDED MATTER.

The northern waters where oysters are grown seem to be clearer and less full of suspended particles, at least in Buzzard's Bay, than in the Chesapeake. This may be one reason why the spat catches in such abundance in certain places, sticking to gravel, dead shells, bowlders, stones, buoys, and all kinds of fixed objects having clean surfaces. It may be that the water of the Chesapeake, holding more sediment in suspension, is less favorable for the attachment of spat than that of the clearer northern oyster regions. At any rate, the deposition of sediment at some places in the Chesapeake proceeds at an unusually rapid rate, which would naturally, as explained above, interfere with the attachment of the fry. This has suggested to the writer the practicability of transporting small spat from the northern waters to the more southern, inasmuch as it seems that a greater proportion of spat will catch and grow on the same area there than in the south. Certain it is that quite young spat may be transported, say from the Chesapeake to Chincoteague Bay, and survive the journey and grow very rapidly, as I had opportunity to learn during the past summer on the grounds of Messrs. Pierce & Shepard. Whether it would be profitable to transport small spat for long distances, and whether it would survive such a journey could, of course, only be learned by actual experiment; but it is possible that the experiment would be worth a trial.

ABSORPTION OF BRACKISH WATER BY SALT-WATER OYSTERS.

The growers who carry on the cultivation of the oyster practice in many places what is called "plumping" or puffing up oysters for market by exposing them for a short time to the effects of water fresher than that in which they grew. One party at Franklin City has actually used steam heat in order to warm fresh water to 65° or 70° Fahr. in winter, so as to get the oysters to open their valves and take in enough fresh water to puff up their flesh and give them a better appearance in the market. By this process the animal does not acquire any additional matter except the water, which is taken up in great amount, but it loses a part of its saltness, and, in flavor, becomes more like an oyster from brackish waters.

EFFECT OF SEA WATER ON BRACKISH-WATER OYSTERS.

It is a remarkable fact that just the reverse effect will be produced on the flesh of oysters which are carried from brackish into water which is more salt. This was shown by taking some oysters from Buzzard's

Bay and bringing them to Wood's Holl, where they were kept supplied with water running from a faucet for several days. At the end of that time the soft parts had shrunken to a remarkable degree and acquired a toughness and leathery consistency in marked contrast with that observed in the animals before the experiment was tried. These effects are produced, as is well known, by osmotic action.

STORAGE FLOATS.

An ingenious system of floats, which are raised and lowered by means of windlasses, are used in this work by Mr. Conger, of Franklin City, Md. This apparatus is a great convenience in storing oysters temporarily near the oyster houses, where they are packed for market. The floats are 20 to 25 feet long and 7 or 8 feet wide, with a bottom made of strong slats. The windlasses are supported on the tops of four piles driven into the mud in two pairs, one at either end of the float.

ECONOMICAL SIGNIFICANCE OF THE STOCKTON EXPERIMENT.

The success in rearing oysters from the eggs, as practiced at Stockton the past summer, admits of no doubt whatever; inasmuch as there could be no question as to the identity of the eggs from which the spat which caught on the collectors was derived. No other ova could by any means have gained access to the inclosure, so as to vitiate our results. But this success I do not esteem of as much value as the facts of collateral importance which it has substantiated. These are the following:

First. It has proved that oysters may be grown in inclosed ponds.

Secondly. It has proved that an abundance of food will generate in such inclosures.

Thirdly. It has proved that we can depend upon the tide to renew the waters of such ponds.

Fourthly. It has been shown that the cost of digging out ponds on an extensive scale would be a comparatively inexpensive undertaking, because no digging is required except such as can be done with a spade. The nature of the salt marsh is such that it can be cut into any shape desired; the black muck of the marsh being interpenetrated with great numbers of roots and decayed fibers of vegetable matter which render it tough, so that it can be cut out in solid blocks. About the depth of what would be taken by three superimposed spadesfull is a sufficient excavation for the purposes of pond culture in many places. There are thousands of acres along the eastern coast of the United States of salt marsh lands which are available for pond culture, besides the ground already occupied off-shore; so that the development of the industry seems to be practically unlimited. Wherever the water is fresh enough to grow oysters, and where such marsh lands also exist, the construction of ponds for oyster culture is feasible on just as grand a scale as is now practiced on some parts of the coast of France.

The writer does not think that the rearing of oysters from artificially impregnated eggs will ever be a profitable business, in that it is likely that collecting spat by simple and inexpensive methods, such as the use of brush, shells, gravel, and other cheap, clean materials, will always yield as good results on a large scale as any artificial method could possibly give. But it is possible that we greatly underestimate the value of wholly artificial methods.

NOTICE OF A PARASITE OR COMMENSAL OF THE OYSTER, WITH REMARKS ON ITS DISTRIBUTION.

About a year since, M. Adrien Certes, of 21 Rue de Jouy, Paris, announced, through the pages of the Bulletin of the Zoological Society of France, that he had met with an organism inhabiting the stomach and intestines of the oyster, which presented some remarkable characteristics, and which was allied to a parasite found in the blood of the frog, and to another species found in the intestines of birds.

The writer first noticed this creature in the stomach and intestines of the American oyster during the summer of 1880, and then supposed it to be nothing more than a small vegetable organism allied to *Vibrio*, and has made some allusion to it under that name in his report to the Maryland Commissioner for that year.

M. Certes has since shown that this identification is an error, as well as a later name which the writer had proposed, namely, *Spirillum ostrearum*. A more critical examination has shown that it is often found in great numbers in the stomach, especially at its hinder extremity, in which a singularly transparent rod is embedded. In this place they are sometimes found in vast numbers. They do not seem to be a true parasite, but are rather to be regarded as a messmate inhabiting the alimentary tract of the oyster. They are very minute, thread-like organisms, which are provided with an extremely delicate, narrow frill or membrane, which is wound spirally around the body of the animal. The living creature moves rapidly across the field of the microscope, looking very much like a minute animated spiral spring, rotating with a screw-like motion through the liquids taken from the stomach and gut of the oyster. This creature has been encountered by the author in the contents of the stomachs of oysters in Washington and Philadelphia; also at different places on the shores of the Chesapeake and Chincoteague Bays, and even as far north as Buzzard's Bay. It therefore seems to be a constant inhabitant of the oyster. It has also been found in other portions of Europe besides the place where it was originally found by M. Certes, who first noticed it in oysters taken from the vicinity of Marennes. This gentleman, in a letter to the writer, dated August 7, says that Professor Möbius has also found it in the oysters of the North Sea. The animal found in the American oyster is apparently very similar if not identical with that found in the flat oyster (*Ostrea edulis*) of Europe.

Professor Möbius has published an account of his discovery in No. 134 of the Zoölogischer Anzeiger, of the 19th of March, 1883.

The discovery of this parasite and its subsequent study was made in precisely the same way as by the writer. The contents of the stomach of the oyster were removed by thrusting a pipette or medicine-dropper into the mouth of the animal, and drawing out by that means the juices and the microscopic food which the stomach contained. Almost every other oyster examined, and sometimes every one, will be found to be inhabited by this creature; but no ill effects, so far as the writer is aware, are traceable to its presence when infested oysters are consumed by man as food. It seems to be a perfectly harmless commensal or pensioner upon the oyster whose stomach it inhabits.

THE FOOD OF THE OYSTER.

The method of removing the contents of the stomach of the oyster with a pipette is valuable for another very important purpose, namely, to learn the nature of the food which the animal had taken shortly before. This season, while examining oysters in Chincoteague Bay, with this object in view, I found that the adults were guilty of swallowing sometimes as many as 200 of their own young at one meal. These young oysters ranged in size from one five-hundredth to one two-hundredth of an inch in diameter, and already had the shell developed; and the larger ones were found to be themselves feeding, inasmuch as food could be seen in their stomachs.

Besides these young oysters a good many oyster eggs were also found amongst the contents of the stomach, together with spermatozoa, diatoms, the very youngest stages of barnacles, and the shells or external coverings of a singular infusorian, which was identified as a species of *Tintinnus*. Of this last organism, several thousands of their shells were sometimes met with in the contents of the stomach of a single oyster.

The fact that adult oysters swallow their own young and eggs shows that they may be, in this way, to some extent, destructive of their own species.

The investigation of the contents of the stomach and intestines of the oyster by the method already described on an extensive scale in different localities along the eastern coast of the United States is important; because it is a well-known fact that the flavor of oysters varies or is affected by local causes which are probably mainly the food and the saline condition of the water in which they grow.

The contents of the stomachs of a great number of individuals could be very readily removed and preserved for investigation by the means which the writer has used. The identification of the minute vegetable and animal remains in such material preserved for study could readily be carried on by specialists versed in the characters presented by the various forms.

Possibly the most important of the food elements of the oyster are diatoms. These free-swimming, minute plants are found in vast num-

bers wherever oysters grow, and are numerous in species; so that the subject would be worthy of the attention of some one who had devoted extensive study to them. By such a course it would be possible to determine whether the diatomaceous flora of a given district where oysters are grown differed essentially from the diatomaceous flora of another; and it might in this way be possible to get at the reason why oysters from different localities differ in flavor.

THE POPULAR DELUSION REGARDING GREEN-GILLED OYSTERS.

For many years green-gilled oysters in England and France have been more highly esteemed by the epicure than the white-fleshed ones; in consequence of which fact the growers have made every effort to cater to this singular taste. They have also found it a profitable taste to cater to; because the green-gilled oysters are higher in price in the markets of Europe than the white-fleshed ones. The only place in the United States, so far as the writer is aware, where this taste has been developed is in the city of Norfolk, Va.; where it is said that green-gilled oysters are worth five cents per quart more than white-fleshed ones. The prevalence of this peculiarity in a large proportion of the oysters from the Chesapeake Bay and Rappahannock River last winter was the cause of a serious decrease in the value of the affected product. Every test, chemical, physical, and gastronomical, which has been tried at the instance of various investigators, has shown that the consumption of green-gilled oysters is never attended with evil effects. In fact, it has been proved that the green color is in no way due to copper, as has been asserted by ignorant or prejudiced persons. In truth, the color is due to a harmless vegetable coloring matter absorbed from the food upon which the animal feeds, and is very nearly identical in composition with the green coloring material found in the leaves of trees.

It is to be hoped that the public mind may be educated up to the point where they will fully comprehend the fallacy of the belief that the green of oysters is due to copper; because it may be said that any such quantity of a copper salt which would produce the green color of oysters would necessarily be fatal to the animal itself.

To sum up, it may be said that the doctrine that the green color of oysters is due to copper is utterly fallacious, and without a shadow of foundation in fact.

It was formerly believed that the acquisition of the green color was confined to the oyster, but I have recently learned that the soft and hard clam are both affected under certain conditions and at certain times by a similar alteration in the tint of the gills, which is doubtless due to precisely the same cause as the same condition in the oyster. This is all the more likely, because the food consumed by these two animals is very similar to that consumed by the oyster; but that they should be in any way deteriorated in quality by the acquisition of this green color is in the highest degree improbable.

WOODS HOLL, *September* 4, 1883.

45.—SPAWNING OF ESOX (PIKE OR PICKEREL) IN NORTH CAROLINA.

By E. H. WALKE.

[From a letter to Prof. S. F. Baird.]

I have been setting gill nets in Salmon Creek. Last Wednesday morning I caught eight pike or pickerel, and four of them were ripe. I tried to impregnate the eggs, but they had been dead too long. I hope to be able to get some more ripe ones. I thought you would like to know what time they spawned.

AVOCA, BERTIE COUNTY, N. C., *February* 21, 1883.

46.—SUMMARY OF DISTRIBUTION OF FISH BY ONE CAR DURING THE PAST SEASON.

By MARSHALL McDONALD.

[From a letter to Prof. S. F. Baird.]

Mr. Moore's report on the season's work has just come in. The following summary will be of interest to you. The number of miles traveled by car No. 1 in the carp, salmon, and shad distributions aggregates 31,993. The number of shad distributed was 6,715,000, of herring 5,550,000, of carp 113,605, and of salmon 450,000.

UNITED STATES FISH COMMISSION, *August* 8, 1883.

47.—THE MOVEMENTS OF SCHOOLS OF MACKEREL.

By S. J. MARTIN.

[From letters to Prof. S. F. Baird.]

The mackerel catchers along this coast are doing poorly. Mackerel are plenty on the eastern shore, but they are small ones, and mesh in the seine, and before they can be picked out the dogfish destroy the netting. Two vessels have come in with seines spoilt. There were five vessels in Boothbay yesterday repairing their seines where the dogfish had eaten them. As I told you in my last letter, the large mackerel come up once a week, stay one hour, and then sink. They are full of feed.

All the vessels which were in the Bay of Saint Lawrence came home with full fares, and have all gone back again. One vessel arrived from the bay this morning with 450 barrels, which she caught in twelve days. She reports that mackerel were abundant when she left. Two vessels

were at the Seven Islands, and found plenty of mackerel, but too near the shore to be caught with deep seines.

GLOUCESTER, MASS., *August* 28, 1883.

Mackerel have been abundant in the Bay of Saint Lawrence during the month of August. All the vessels which were there got full fares. I have been informed by Captain Smith, of the schooner Fred. P. Fry, that there is plenty of food for the mackerel in the bay, an animal which the fishermen call "all eyes." He says there are small mackerel, not over two inches long, all along the coast of Prince Edward Island. Most of the vessels which have arrived from the bay are going back, and some that were fishing on this shore have gone there. Captain Smith says that the school of mackerel which was on this shore last year is the same one which is in the Bay of Saint Lawrence this year.

It is a hard thing to keep the run of the mackerel on this coast. Some vessels after being away four weeks come home with no fish. Others return in three weeks with full fares. The latter is not often the case this year. Two vessels arrived last Wednesday with full fares of large mackerel, caught 30 miles S. E. from Petit Manan light, Bay of Fundy. They saw their mackerel in the night. In three nights the two vessels caught 340 barrels each. The mackerel were large, and out of 340 barrels 150 barrels were number ones, very large, and fat as pork; the fattest mackerel I have seen on the coast in the last five years. The small mackerel which were so plenty on the coast have disappeared. They show up once a week. The fact that the mackerel are so fat shows that their food is all below the surface of the water. I think if the vessels had all carried their bait-mills, and had plenty of bait, they could tole plenty of mackerel to the surface. Schooner Frank Foster arrived last Thursday from the Bay of Fundy. The captain says he caught 40 barrels of large mackerel on a hook and line, and that he could tole them up with bait anywhere to the eastward of Mount Desert Rock.

Squid have been very plenty this season. During the months of July and August there were plenty of squid at Barnstable Bay, Grand Banks, Green Bank, George's Bank, Western Bank, and all along the Nova Scotia shore. Last Wednesday the schooner Northern Eagle, thirty-five miles southeast from Monhegan Island, Me., fell in with what was supposed to be a school of mackerel. The crew set their seine and caught 100 barrels of squid. Schooner E. W. Merchant caught a load of squid at Saint Ann's, and carried them to Saint Pierre, Newfoundland, but could not sell them. She then went to the Grand Banks, but there were so many squid there that she still was unable to dispose of hers. She then brought them home and stored them.

GLOUCESTER, MASS., *August* 31, 1883.

48.—NOTES ON THE FISHERIES OF GLOUCESTER, MASSACHUSETTS.

By S. J. MARTIN.

[From letters to Prof. S. F. Baird.]

THE MACKEREL FISHERY.—There have been ten arrivals from the Gulf of Saint Lawrence bringing 3,490 barrels of salt mackerel. All report mackerel to be plenty in the vicinity of Prince Edward Island, and some of the mackerel catchers are going back to the bay. The large mackerel are scarce on this shore. I do not think mackerel come to the surface much, for the following reason:

Capt. George H. Martin came in last Monday with 130 barrels of mackerel, 120 barrels of which he caught in one day, August 16, on the western part of the Seal Island grounds. At sunrise the mackerel came to the surface as far as the eye could see. He set a small seine and a large one. In one hour after he had taken the 120 barrels, there was not a fish to be seen. He staid on the same ground eleven weeks, when the mackerel again came to the surface and staid half an hour. Some of the vessels got good hauls. This has been the case off Mount Desert, Matinicus, and Isle au Haut. The mackerel are full of red-seed, called by the fishermen "cayenne." When the mackerel are plenty there are also many birds hovering over the water.

PORGIES.—Porgies are plenty now. Nine vessels baited in Salem Harbor. There are two vessels at Salem seining porgies. The weirs at Portsmouth are full of porgies. There are also plenty at Newburyport and Hyannis.

The cod fishermen on the Grand Banks are all coming home with full fares, and they report a plenty of squid at the Grand Banks.

GLOUCESTER, MASS., *August* 22, 1883.

MONTHLY SUMMARY.—The amount of fish landed at Gloucester during the month of August was as follows: Eighteen vessels from the Gulf of Saint Lawrence brought 6,184 barrels of salt mackerel; one hundred vessels from the Eastern Shore landed 13,404 barrels of salt mackerel; 305 barrels were caught in traps in the vicinity of Cape Ann; one hundred and eight vessels arrived from Georges Bank with 1,808,000 pounds of salt cod, and 57,000 pounds of fresh halibut; twenty vessels arrived from the Western Bank with 122,000 pounds of salt codfish, and 10,500 pounds of salt halibut; one vessel arrived from Banquereau with 280,000 pounds of salt codfish, and 3,000 pounds of salt halibut; forty-two vessels from the Grand Banks brought 5,665,000 pounds of salt codfish and 61,000 pounds of salt halibut; nineteen vessels from Grand Bank also brought 768,000 pounds of fresh halibut. The shore vessels landed 19,000 pounds of salt pollock, 24,000 pounds

of salt codfish, 100,000 pounds of salt hake, and 1,000 pounds of salt cusk. The small boats landed 20,000 pounds of fresh fish (mixed), 2,000 pounds of fresh codfish, 200,000 pounds of hake, which was sold to split on the wharf. There were landed by the mackerel catchers 2,000 pounds of fresh swordfish, 62 barrels of salt swordfish, and 200 barrels of salt herring. There were caught with seines in the vicinity of Cape Ann 93 barrels of porgies, which were sold fresh for bait. Forty barrels of porgy slivers were sold for mackerel bait to use in the bay. Seventeen thousand quintals of dried hake arrived by freight from Maine. Two hundred and forty barrels of small mackerel were sold to the canning factories.

GLOUCESTER, MASS., *August* 31, 1883.

THE MACKEREL FISHERY.—The prospect for this fall looks better. No mackerel are seen in the day-time; they are all taken by night, and on the dark of the moon. Though mackerel can be seen 7 fathoms below the surface, none have been seen in the day-time. They can be seen plainly at night. When the water "fires," the mackerelers say they are easier to catch. On the mackerel grounds there are plenty of squid, which go in large schools. One vessel took 150 barrels at one haul of the seine, and salted 40 barrels of them to bring home. Mackerel are very fat now. Captain McLean told me this morning that he had not seen a school of large mackerel on the surface of the water near the Eastern Shore since the 1st of July, nor has he seen them feeding at the surface this summer. Those taken are full of "red feed." The mackerel lay in large schools 7 to 8 fathoms below the surface. Last Saturday night eight vessels got 150 barrels each, while other vessels near by took none. If the mackerel come to the surface the vessels will do well. Mackerel sold to-day at the high price of 15.50 dollars per barrel.

GLOUCESTER, MASS., *September* 13, 1883.

THE MACKEREL FISHERY.—This is improving. Three vessels arrived this morning with 250 barrels each, and they report mackerel plenty. These were taken 30 miles southeast from Isle au Haut. At that point the mackerel came to the surface as far as the eye could see on September 11. They are mixed—one-third large and two-thirds small. The school is working to the westward and some large mackerel have been caught off Boon Island. Some large shad are caught with the mackerel. The schooner W. H. Cross, Captain Foster, set a seine around what was supposed to be a school of mackerel and caught ten barrels of mackerel together with fourteen barrels of large shad. The shad were very large and sold for $12 a barrel. These shad were taken off Seguin, near the mouth of the Kennebec River. The squid are plenty in the vicinity of the mackerel schools, and annoy the mackerel seiners, for when they catch mackerel in the night sometimes they set their seines around what they suppose to be mackerel and find their seine

full of squid. Small mackerel have been schooling in Boston Bay the past week in large numbers. The red feed is on the surface of the water in Boston Bay, and if the weather is good I think the catch of mackerel will be larger after September than it was last year. High prices rule as follows: extra No. 1, $23 per barrel; common No. 1, $19 per barrel; No. 2, $14 per barrel; No. 3, $10 per barrel; and No. 4, $6.50 a barrel.

GLOUCESTER, MASS., *September* 16, 1883.

MACKEREL.—During the past week twenty-eight mackerel vessels have landed 6,800 barrels. Most of these were caught off Matinicus, SE. 30 miles. The mackerel are mixed, some schools being all large and some all small. One vessel caught 300 barrels of mackerel four miles from Monhegan. Last year, at this time, most of the mackerel were caught to the westward of Portland. Last Wednesday they were seen schooling as far east as Mount Desert and Grand Manan Bank. They were also plenty in the Bay of Saint Lawrence. The twenty vessels that were at the Bay of Saint Lawrence averaged 200 barrels each. The schooner Edward Webster, Capt. Solomon Jacobs, is bound home with 500 barrels, having been absent five weeks. This is his second fare from the Bay of Saint Lawrence. On the previous trip he brought home 500 barrels, having been gone six weeks. The indications now are that the fall catch will be large. One schooner arrived to-day with 210 barrels of salt mackerel caught 20 miles southeast from Matinicus, having been gone from home eight days. They were large mackerel.

When mackerel come to the surface they come up in different places on the same day. On last Wednesday they came up schooling off Mount Desert, off Matinicus, off Monhegan, on Cashe's Bank, and on Grand Manan Bank—on the same day! The water is quite warm. It was 52° to day, while last year at this time it was 42°.

GLOUCESTER, MASS., *September* 23, 1883.

HERRING.—Last Saturday night there were 75 barrels of large spawning herring caught, and last night 60 barrels more. This is ten days earlier than last year. There was none of any amount caught last year until the first week in October. Last year when they came the temperature of the water was 42°. This year it is 52°, and those of this year are larger than last year.

GLOUCESTER, MASS., *September* 24, 1883.

MONTHLY SUMMARY.—The amount of fish landed at Gloucester during the month of September, 1883, was as follows: Cod brought from George's Bank, 1,259,000 pounds; halibut from George's Bank, 16,335 pounds; cod from Grand Banks, 640,000 pounds; salt halibut from Grand Bank, 59,200 pounds; cod from Western Bank, 520,000 pounds; salt halibut from Western Bank, 4,750 pounds; fresh halibut from the banks, 507,000 pounds; salt mackerel caught on the Eastern Shore, 20,534 barrels; mackerel from the bay of St. Lawrence, 1,165

barrels; herring, 527 barrels; porgie slivers, 231 barrels; pollock, 67,000 pounds; hake, 260,000 pounds; haddock, 40,000 pounds; swordfish, 11,350 pounds; shad caught in the mackerel seines, 104 barrels; hake, 1,600 quintals; clams, 10 barrels; cod brought from Maine, 400 quintals; mackerel from Canso, Nova Scotia, 80 barrels; salt halibut from Greenland, 390,000 pounds.

MACKEREL MOVEMENTS.—Mackerel are working to the westward. Some vessels have obtained good hauls of mackerel in Ipswich Bay. Last Saturday night a vessel caught 120 barrels of mackerel in Ipswich Bay. They were large mackerel. Mackerel, herring, porgies, and squid are found all in the same locality. One vessel will get 50 barrels of mackerel in a seine, while another alongside will get 50 barrels of herring. Shad are mixed with the mackerel and herring. The porgies school separately. Squid are plenty from Mount Desert to Thatcher's Island.

GLOUCESTER, MASS., *October* 3, 1883.

HERRING.—Herring were plenty in the Gloucester harbor last night. This morning 1,500 barrels of herring were picked out of the nets. There were 65 boats, with 665 nets out for them. Some of the nets touched the bottom, others sank, having so many herring in them. One boat with 8 nets caught 100 barrels. The herring are full of spawn, and are very large. The catch of herring to the eastward has been small, and 25 vessels of the eastern fleet came up and set their nets in our harbor.

MACKEREL.—The mackerel fishermen are doing well. Four came into the harbor yesterday with fresh mackerel. There are four in today dressing mackerel. They are anchored 12 miles south of Thatcher's Island, and you can see them from the hill. I saw 25 vessels with jibs down dressing mackerel this morning. Those that have been brought in are one-third large. If the weather holds good I think the mackerel fleet will do well. Mackerel were schooling off Seguin last Thursday. Last year there were not many mackerel caught in the month of October. But the prospect is good now.

COD AND HADDOCK.—The Grand Bank cod fleet has most all returned. The vessels that went to Greenland are all back but one. They only caught half fares, and report rough weather on the Greenland coast this summer. As fast as the Grand Bank fleet comes home they fit out for haddock fishing. There will be a large haddock fleet this winter.

GLOUCESTER, MASS., *October* 7, 1883.

49.—STOCKING THE STREAMS OF MONTANA WITH FISH.

By Governor JOHN SCHUYLER CROSBY.

[Letter to Prof. S. F. Baird and reply of the latter.]

I have great pleasure in laying before you a copy of a joint resolution of the legislature of this Territory as follows:

COUNCIL JOINT RESOLUTION in relation to the fish interests of Montana.

Resolved by the Legislative Assembly of the Territory of Montana, That his excellency John Schuyler Crosby be, and is hereby, requested to communicate with the United States Fish Commissioner, with a view to having the streams of the Territory stocked with fish, and also for the purpose of calling their attention to the obstructions in the Clark's Fork of the Columbia River, which prevents salmon from ascending it into the Territory of Montana, and which obstruction can be removed at small expense.

Our water-courses are many thousands of miles in extent. Our laws for the preservation of fish are very strict. Our people are deeply interested in the subject-matter of your Commission. We shall aid you with all our heart and thank you gratefully for helping us to stock our streams and rivers. I believe a better opportunity for conducting your experiments on a great scale to most useful ends is rarely offered than by this Territory and a people entirely interested in the matter.

I have the honor to ask you to send at the proper season an agent of your Commission to this Territory, with such supply of spawn or breeding fish as may seem to you proper. Every facility to carry out the end proposed by the resolution transmitted will be given you.

I earnestly indorse the desire of the legislature that the obstructions on the Columbia River (Clark's Fork) may be removed and permit the salmon to reach the thousands of miles of unobstructed water above.

HELENA, *February* 17, 1883.

REPLY BY PROFESSOR BAIRD.

Since the receipt of your letter of the 17th ultimo, informing me of the joint resolution in relation to the fish interests of Montana, I have concluded to send one of our most competent experts to make an examination of the Columbia River for the purpose of learning how best the great fishery interests of that stream can be preserved, and will instruct him to place himself in communication with your excellency while making the examination. We will be glad to avail ourselves of your kind offer of assistance.

I would suggest that it would not be amiss if you would cause to be

made a careful survey of the obstructions at Clark's Fork to which the resolutions refer. A topographical map of the stream about these obstructions would enable us to advise how best the obstacles to the ascent of fishes can be surmounted. A record of the temperatures throughout the year of some of the principal lakes and rivers of the Territory would be important information for enabling us to advise you as to what varieties of useful food-fishes these waters will best sustain.

WASHINGTON, D. C., *March* 2, 1883.

50.—ON THE IMPROPRIETY OF DEPOSITING WHITEFISH MINNOWS OFF THE HARBOR OF CLEVELAND, OHIO*—FISHING FOR SAUGERS.

By Dr. E. STERLING.

[Letter to Prof. S. F. Baird.]

There is not a place on all Lake Erie so illy adapted to the successful planting of whitefish as off this harbor. To begin with, there were never 500 pounds of this fish taken by seine, gill-net, or in pound since my remembrance, and I have known gill-nets to be set from 1 to 3 and 8 miles out and pounds innumerable, by experienced fishermen, and the above is near the result. A whitefish taken in this way is a rare occurrence. In the second place, since the almost fishing out of the blue and wall-eyed pike, the "sand pike," "sauger" (*Lucioperca canadensis*), have increased in such numbers that scarcely any other fish can exist. To give you an idea of their numbers, many fishermen make a business of furnishing boats, bait, and tackle to the thousands of citizens that can only enjoy fishing at home. On any day in season, spring and fall, you will see from fifty to one hundred small boats, carrying from three to thirty persons, busily pulling in this little sauger. One Sunday last May I counted, off the river mouth, extending each way a mile or more, 125 small boats. filled with men, women, and children, all fishing. At a low estimate there were nearly 400 at this sport. A low average for each person would be ten fish, making the catch for the crowd 4,000 saugers. This fish can be taken almost as readily through the ice, but few undertake it, owing to danger and exposure. This fishing for saugers has been going on for 15 years or more and still they do not diminish, in fact they are on the increase as well as the black bass. After the crib and water construction, twenty-five years ago, the "sauger" was quite scarce here, as it is at most points on the lake. Why it should have increased here in such numbers I am unable to explain. It cannot be the extirpation of other carnivorous fish, for they have been cleaned out alike the lake over, but in no place followed by an increase of the "sauger."

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* This article was called forth by the U. S. Fish Commission making a deposit of a million young whitefish off the harbor of Cleveland, Ohio. The selection of a place was intrusted to Mr. F. N. Clark, who makes reply on page 349.—C. W. S.

The nearest whitefish grounds to Cleveland are in Dover Bay, 13 and 14 miles to the west. Rocky River intervenes 7 miles west of here But no fish of any account are found at or about the mouth of this stream. Dover Bay was not found to be a whitefish ground until within a few years, when, in their competition for the ordinary fishes, the fishermen pushed their pounds out to where the whitefish lay. The catches on the first discovery often ran from 3 to 5 and 8 tons; so great sometimes was the catch of a day that a market could not be found. The fish then ran large; now they run half the size and no trouble about a market. The fishermen at the time of the first catch supposed the whitefish had run in there for them, but the explanation is that in their greed to extend their pounds beyond each other they finally reached the ground where they lay. The whitefish very seldom approach the shore nearer then half a mile. The fishing grounds at Dover Bay, and many other places along Lake Erie shores, are owned and leased by them. They are, comparatively speaking, wealthy men; for this reason I do not understand why Uncle Sam or the State of Ohio should stock their waters gratuitously any more than their farms. I was out there five years ago and laid out a plan so they could help themselves; they have the finest facilities without the help of steam or wind-mill power, and can have 20,000,000 eggs every fall if they want them.

CLEVELAND, OHIO, *February* 26, 1883.

51.—WHAT DANGERS THREATEN THE PRODUCTS OF THE OLD POND CARP FISHERIES FROM ARTIFICIAL FISH CULTURE?*

By von TRESKOW-WEISSAGK.

At the present time fish culture is a subject in which the great public takes a lively interest, which is no longer confined to men of science, but which is shared by many people who formerly discussed the fish question only when they had before them some fine specimen of fish temptingly prepared for the table. At present there is actually a mania for fish culture and for carp-ponds. Landed proprietors ought to tremble when they read how many millions of young fish of the choicest kinds are annually placed in brooks, rivers, and lakes.

It seems but natural to suppose that when the objects of fish culture are fully reached, the products of the old pond culture will have to meet a very serious competition. The carp is a product of agriculture; a great portion of the territory used as ponds could again be transformed into fields, meadows, and forests; and just as our German farmers are compelled to lower the price of their products owing to the importation of American meat and grain, we, the pond culturist, of Germany, might

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* "*Welche Gefahren drohen den Produkten der alten Teichfischerei durch die künstliche Fischzucht?*" In "*Deutsche Fischerei-Zeitung,*" Vol. VI, No. 15, Stettin, April 10, 1883. Translated from the German by HERMAN JACOBSON.

also see serious competitors of our pond fish in the cheap salmon and trout which fish culture is expected to bring into the market, and which would in future relegate our carp to the place which at present is occupied by the smelt.

But as yet we are not afraid. Any one who, like myself, counts his carp twice every year, and who keeps a strict account of his ponds and their inmates, who, therefore, can, even before the fish are ready for the market, ascertain with tolerable accuracy what his losses will be, and who knows that a few pike may destroy a large stock of young carp fry in five or six months, will feel sorry for the millions of young fry which, hardly hatched, must, in all open waters, without fail, soon become a prey to fish-of-prey.

I believe that if half the money which at the present time is spent on hatching fish-eggs would be used for placing the young fish in ponds absolutely free from fish-of-prey, even if only for one year, so that they could reach a greater age by the time they are placed in open waters, there would be a possibility of seeing again some of these salmon in a condition to fit them for the table. But as things are managed now it is hardly possible that future fish harvests will pay for the present expense; even if here and there some specimens of the choicer kinds of are caught, this must be considered a very poor result of the stocking of the open waters with millions of young fry.

It requires a certain amount of moral courage for a man to state publicly that he does not believe in the stocking of our lakes and rivers with fine fish by means of placing in such open waters fish of a tender age which still need a good deal of protection. But I feel constrained here to make this very statement.

Our fishery legislation, moreover, extends but little aid to the earnest pisciculturist in his endeavors to stock open waters with fish. He sows, but others reap the harvest; with great trouble he hatches the young fish, only to see his neighbors across the river, or below or above him, share the fish harvest without any expense on their part. I will, in this connection, only mention the Dutch, who catch nearly all our salmon when they are on their downward journey, and who would also consider as welcome prey the products of German fish culture in the Rhine. Unless a similar policy is followed with regard to bodies of water as with regard to forests, unless alrge portions of a river are, by compulsory measures, formed into a large fishing district, similar to the hunting districts in our forests, even the most earnest endeavors to increase the stock of fish will remain in vain.

We, the pond cultivators, therefore watch with eager interest the progress of fish culture; we acknowledge that in certain specially favored localities favorable results may be seen, but so far at least we are not afraid that the products of fish culture will either crowd out of the market our good old carp or lessen its price.

Vol. III, No. 20. Washington, D. C. Oct. 18, 1883.

52.—NOTES ON THE EDIBLE QUALITIES OF GERMAN CARP AND HINTS ABOUT COOKING THEM.

By CHAS. W. SMILEY.

The introduction of carp into the United States is of so recent date that there has been, as yet, but little opportunity to grow them of sufficient size to eat; or to get a full expression from our people of their opinions of carp as food. The first distributions by the United States Fish Commission were in 1879 and 1880. Many of those fish were put into unsuitable places and perished. Many persons whose carp have survived have prized them so highly that they have persistently refused to allow any to be eaten. As, however, an occasional newspaper muttering has come to hand, it has been thought best to get together at once what information might be available.

About the first of July, 1883, a circular was prepared containing fifteen questions, covering the whole field of carp-culture. One of these questions was as follows: "Have you eaten carp? How were they cooked, and what was the opinion of their edible qualities?" This circular was sent out, July 20, 1883, by direction of Professor Baird, to all persons who appeared from the records of the United States Fish Commission to have received young carp in 1879 and in 1880.

There have been received thus far over 600 replies, and from these have been copied verbatim everything which correspondents have said with reference to this subject. Over 350 had not yet tasted carp.

Finding that there was an occasional remark of an uncomplimentary character, I inquired of Professor Baird with reference to publishing any adverse statements. In reply, he said: "Certainly it is not our policy to suppress honest criticism of the carp, and you are authorized to collate the testimony and publish both sides. NO FISH IS FIT TO BE EATEN DURING AND IMMEDIATELY AFTER THE SPAWNING SEASON. Unless criticisms have been made of the fish during the late fall or early spring they do not affect the question." I have accordingly classified and will present herewith every scrap of testimony—good, bad, and indifferent—which has been received in reply to these circulars, together with such incidental remarks as had previously reached the United States Fish Commission. Of these latter, there are not over half a dozen, and they are mostly indicated by an earlier date attached.

I have spoken thus definitely concerning this material because when treated with exact impartiality the opposition to the food qualities of carp dwindles down into such utter insignificance that some one might easily suspect me of culling the material. This point is especially to be guarded, because it is so often considered praiseworthy to suppress criticism which is prompted by ignorance of facts and which might unjustly injure a good cause. And I am very sure that every unfavorable

opinion of carp herewith presented, except perhaps that of Mr. Epes, is based upon ignorance or forgetfulness of one of three facts:

I. No fish should be eaten during or immediately after the spawning time.

II. The muddy taste of any fish can be largely removed by keeping the fish alive in a tub of pure water, changing it daily for a week.

III. Bad cooking will spoil the best of food.

Reports upon the edible qualities of carp have been received from twenty-three States and Territories, as follows:

Table showing the number of each kind of reports received from the various States and Territories.

State.	I. Fair to very good.	II. Emphatic praise.	III. Favorable comparisons with other fish.	IV. Sometimes soft or muddy.	V. Criticisms.	VI. Bones.	VII. Cooking.	Total.
Alabama	1	3	1				1	6
Colorado			1					1
Connecticut				1			1	2
Georgia	1	11	4	1	1	1	3	22
Illinois		3						3
Indiana							2	2
Kansas						1	1	2
Kentucky		6			3	1	3	13
Maryland	6	21	16	4	2		7	56
Mississippi		5	3		1			9
Missouri		1	2		1	1		5
New Jersey	1			1	1	1		4
New York	2	1		1			2	6
North Carolina	3	6	2	1				12
Ohio	4	4	2	1	1		4	16
Pennsylvania	2	2	1	2			2	9
Rhode Island		1						1
South Carolina	1	1	2					4
Tennessee	4	5	3	2		1	1	16
Texas	3	12	1					16
Utah							1	1
Virginia	7	14	1	4		1	1	28
West Virginia	4			1			1	6
Canada, etc	1						1	2
Total	40	96	39	19	10	7	31	242

For convenience of reference the testimonies are classified as follows:

	Numbers.
I. Moderate praise, from fair to very good, 1–40	40
II. Unqualified praise and very emphatic expressions of approval, 41–136	96
III. Comparisons with other fish, very generally complimentary, 137–175	39
IV. Criticisms as to softness or muddy taste, 176–194	19
V. Indifferent and uncomplimentary reports aside from muddy taste and softness, 195–204	10
VI. A few opinions in regard to bones, 205–211	7
VII. Favorable reports, containing hints upon various ways of cooking carp, 212–242	31
Total	242

Of these 242 reports, 38 only contain the slightest reflection upon carp (Nos. 141, 144, 149, 151, 159, 166, 176–194, 195–204, 208, 209, 210). Many of these objections are declaredly slight. All but one (No. 194) of the criticisms have already been explained away, and I believe we possess the clew to that one.

1. MODERATE PRAISE—VERY FAIR TO VERY GOOD.—In this list are included 40 testimonies, entirely satisfactory in character; 21 of which, in speaking of the edible qualities of carp, pronounce them "good," 14 "very good," and 5 "fair," "very palatable," &c. These statements come from thirteen different States of the Union; but rather largely from Maryland, Virginia, West Virginia, Tennessee, and Ohio. Messrs. Wilmot (5), White (21), Peirce (22), and Duke (39) are men of very large experience with fish, and weight should attach to their testimonies. The method of cooking most frequently named is frying, though all methods are included in this group of statements.

2. UNEQUIVOCAL PRAISE AND VERY EMPHATIC EXPRESSIONS OF APPROVAL.—Under this head are grouped 96 different testimonies. Of these, 15 speak of carp as "very fine," and 21 as "excellent"; and others ring the changes on such expressions as "very good indeed," "first rate," "first class," "extra," "splendid," "very superior," "superb," "delicious," "the best of fish"; while quite a good many go on to say that carp are equal or superior to any other fish, or that they never ate anything more delicious. Such testimonies in so large number are, of course, very gratifying, although the Fish Commission has never pretended that carp would take as high a rank as many of these people have given it. These assurances come largely from Maryland, Virginia, Texas, Kentucky, and Mississippi—sixteen States in all. Among the writers are several men of distinction, such as State fish commissioners, editors, physicians, and farmers and planters of wide experience. In many cases the single testimony represents the opinions of whole families or neighborhoods.

3. COMPARISONS WITH OTHER FISH.—Some 39 correspondents have chosen to express their opinions by comparisons rather than in absolute terms; and here we have carp successively declared equal to buffalo, mullet, suckers, mud-fish, croakers, mill-roach, perch, rock-fish, drum, bass, trout, sun-fish, red-horse, mackerel, red snapper, and shad.* Of course the Commissioner, in bringing carp from Germany, did not for a moment suppose that he was introducing a fish equal in delicacy to trout, bass, or shad; but he has always claimed that its edible qualities were equal or superior to those of such fish as suckers, catfish, perch, buffalo, mullet, and sun-fish, and that by reason of its rapid growth, hardihood,

* Most of the fish with which carp have been compared unfavorably are carnivorous species. To raise these on meat is expensive. Carp are vegetable feeders, and adapted to districts where fish are scarce and so remote from the ocean that sea fish cannot be obtained, but where corn, cabbage, pumpkins, squashes, potatoes, &c., are abundant and cheap. The Commission does not offer nor commend carp to those who have access to the better sea fish, such as salmon, trout, whitefish, &c. Compared with vegetable feeders, there is no question of the great superiority of carp.

and simple diet, it was more desirable for pond cultivation. Several of these replies (Nos. 100, 101, 140, 177, 186) indicate that scale carp are received more favorably than leather carp, while none speak of leather carp as superior to the scaled variety. In making these comparisons with other fish, all but six (Nos. 141, 144, 149, 151, 159, 166) place carp ahead of the fish with which they compare them. The reports cover the same wide range of territory as those in the preceding groups; here, as in the previous divisions, however, Maryland furnishing the larger number. The earliest distributions of carp were made to this State, probably on account of its proximity to Washington.

4. CRITICISMS AS TO SOFTNESS OR MUDDY TASTE.—Under this head are gathered 19 reports, a part of which speak of the carp as tasting muddy, and part alluding to their softness. Under other heads, No. 144 speaks of an "earthy taste," and Nos. 187 and 213 testify that soaking in salt water removed this taste. It may also be stated that removing the fish from a muddy pond, in which they would necessarily partake somewhat of the nature of their food, to a tank or tub of fresh water for a week, would very largely purify their systems. Carp is no exception to the rule that the flesh of animals will be affected by their food, but fish are exceptional in the ease with which this difficulty may be overcome. Many who have spoken of carp as being soft have betrayed their ignorance of the fact that the flesh of all fish becomes soft and unsuitable for food during, and for a time after, spawning. Some of these correspondents have stated the time of the year when they ate their carp, thus conclusively proving this hypothesis. Particular attention is called, in this connection, to Nos. 39, 181, 190, 191, 192, 193. In regard to No. 194, it can only be said now that the water of the tank in which the gentleman kept his carp must in some way have become contaminated and have imparted its injuriousness to the carp. It is intended, however, to make a special investigation of this case, to ascertain what the contamination consisted in. While some have spoken of the sweet taste of carp (Nos. 55, 139, 189, 222), only Mr. Epes has objected to them as "too sweet" or "sickening."

5. OTHER UNCOMPLIMENTARY REPORTS.—Of the 194 testimonies above considered, none have presented unexplainable objections except perhaps Mr. Epes. We now come to 10 testimonies, most of which are lacking in particulars, in which are used such expressions as "nothing extra," "unfavorable," "very poor," and, in three cases, "unfit to eat." There is, however, nothing to contradict the supposition that these people tried their carp in the spawning season, in which, as has already been said, any fish is unfit to eat. The anonymous newspaper clipping, No. 204, well illustrates the exaggerations in which people sometimes indulge when they know that they can conceal their names.

6. THE BONES.—Most people have given up the ridiculous hunt for a fish without bones; but, while four (Nos. 141, 208, 209, 210) have found more bones than they liked in the carp, six (Nos. 136, 185, 205, 206, 207, 211) found fewer bones than they expected.

7. HINTS UPON COOKING.—In 31 additional cases, correspondents, all praising the flavor of their carp, have added some suggestions as to the method of cooking. It is quite noteworthy that every person who has imparted some information about the proper methods of cooking has praised the carp. All methods of cooking have indorsements but the large majority speak of frying. The number of times that different methods of cooking have been mentioned is as follows: Fried, 163; baked, 35; boiled, 20; broiled, 14; stewed, 5; a combination of boiling and baking, 2.

One (No. 91) advises frying the young and baking the old, and those who recommend baking usually speak of using large fish. The recipe in No. 242 is especially commended to those who would fry carp. The author of the wine method (No. 238), Mr. Blackford, will be recognized as one of the New York commissioners, and the retail fish-dealer of the Fulton Market.

I.—MODERATE PRAISES—FROM FAIR TO VERY GOOD.

1. FAIRLY GOOD.—I have eaten three mirror carp that unfortunately jumped out of a tub of water one night. Their edible quality was fairly good. They were fried in butter.—THEODOTUS GARLICK, *Bedford, O.*

2. FAIR.—Yes; fried; fair edible fish.—N. BLACKWELL, *Bartlett, Tenn.*

3. FAIR.—We have eaten them; they were fried, and of fair quality.—B. C. HINNANT, *Daingerfield, Tex.*

4. VERY PALATABLE.—Fried in bacon grease they are very palatable.—JOHN M. FERGUSON, *Alderson, W. Va.*

5. NOT INFERIOR.—As a table fish carp is not of an inferior quality by any means, and is largely consumed in the principal cities of Central Europe, as Vienna, Berlin, and Paris.—S. WILMOT, *New Castle, Ont.*

6. GOOD.—We ate four fried. They were good.—SOLOMON BYER, *Norton, Ohio.*

7. GOOD.—We have eaten a dozen or more, fried. All pronounce the fish good.—E. A. WELCH, *Catonsville, Md.*

8. GOOD.—Yes; they were cooked in water and eaten with butter sauce. The opinion of their edible qualities was a good one.—G. HILLJE, *Schulenburgh, Tex.*

9. GOOD.—My family has, and said it was good. It was boiled. It was taken in hot weather in July.—E. B. WOODRUFF, *Morristown, N. J.*

10. GOOD.—I have. They were fried. The flavor was good.—Mrs. S. A. TEEL.—*Kyle, Tex.*

11. GOOD.—They were cooked by a recipe from an English cook-book, and were good.—SAMUEL HOPKINS, *Highland, Md.*

12. GOOD.—Two. Fried in butter. Good.—LEWIS W. RUNNER, *Morgantown, W. Va.*

13. GOOD.—I have eaten but one, and was pleased with its flavor.—E. B. ISETT, *Spruce Creek, Pa.*

14. GOOD.—I ate the two caught a year ago last spring. Fried, they are good fish.—J. M. MCADOO, *McEwen, Tenn.*

15. GOOD.—We have eaten but one, and that was fried. We think they are a good fish.—J. B. HAWXHURST, *Homowack, N. Y.*

16. GOOD.—We ate one fried, and pronounced it good.—S. P. MCFALL, *Newton Falls, Ohio.*

17. GOOD.—Have eaten them boiled and fried, and think them a good fish.—WILLIAM SHIRLEY, 5 *S. Calvert street, Baltimore, Md.*

18. GOOD.—We have eaten three fried. Their quality was good. I like them well.—J. B. HAGER, *Board Tree, W. Va.*

19. GOOD.—Have eaten some fried, and found them good.—R. D. MILLER, *Farmville, Va.*

20. GOOD.—One; fried. Good.—ABNER T. HOLT, *Bolingbroke, Ga.*

21. GOOD.—One small scale carp, accidentally killed in draining the pond, was fried as a pan-fish, eaten in my family, and pronounced good.—C. S. WHITE, *Romney, W. Va.*

22. GOOD.—I have not yet tasted carp. I prize my large ones too highly to kill them. Several friends have tested their table qualities, and all pronounce them good.—MILTON P. PEIRCE, *Philadelphia, Pa.*

23. GOOD.—I heard my son say he ate one, and that it was good.—DAVID BOWMAN, *Timberville, Va.*

24. GOOD.—Have eaten one fried, and found it good.—SOLON M. BOWMAN, *Timberville, Va.*

25. GOOD.—I ate one last year; don't remember how it was cooked. The edible qualities were good.—A. F. WHITMAN, *Nashville, Tenn.*

26. GOOD.—I have eaten only one. It was stewed, and part of it was fried. I consider it a good fish.—JAS. A. PETERKIN, *Fort Motte, S. C.*

27. VERY GOOD.—Yes. In the winter of 1882–'83, the pond was drained by muskrats and the carp were killed. The older ones then weighed nearly 3 pounds. They were considered very good eating.—RUSH TAGGART, *Salem, Ohio.*

28. VERY GOOD.—Two; fried; very good.—WILLIAM I. DUNN, *Sepulga, Ala.*

29. VERY GOOD.—Yes; boiled, baked, and fried. The edible qualities were very good.—P. C. CARLTON, *Statesville, N. C.*

30. VERY GOOD.—Only one; very good.—DAVID FARLOW, *Level Plains, N. C.*

31. VERY GOOD.—Those taken we ate. They were fried, and considered very good.—A. J. MICHENER, *Colora, Md.*

32. VERY GOOD.—Yes; and consider them very good. We ate one yesterday; fried.—FREDERICK ZAHN, *Frizellburgh, Md.*

33. VERY GOOD.—The one I caught was fried, and was thought very good.—R. WELBY CARTER, *Upperville, Va.*

34. VERY GOOD.—I had one fried, and considered it a very good fish. It weighed 2½ pounds.—W. J. PRICE, *Fincastle, Va.*

35. VERY GOOD.—I caught one last year weighing about one-half

pound, which was cooked and thought very good by the family.—JAMES A. VAN BRUNT, 75 *South street, New York, N. Y.*

36. VERY GOOD.—I have eaten some, fried. I suppose they would eat better to some party who had not raised them. Others who have eaten them pronounce them very good.—FRANK W. GREEN, *Nashville, Tenn.*

37. VERY GOOD.—Fried. I thought they were very good.—WM. ARBAUGH, *Carrollton, Md.*

38. VERY GOOD.—We have eaten only two; fried in a pan. They were very good.—W. W. GRIER, *Charlotte, N. C.*

39. VERY GOOD.—I ate one of about 1 pound weight in 1882, and another this spring. I thought them very good. This fall, after they have recovered from spawning, I will try another large one.—RICHARD T. W. DUKE, *Charlottesville, Va.*

40. GOOD AND VERY GOOD.—We have eaten one. It was fried in lard, and was pronounced good, and very good.—MICHAEL SHANK, *Harrisonburg, Va.*

II.—UNQUALIFIED PRAISE AND VERY EMPHATIC EXPRESSIONS OF APPROVAL.

41. VERY GOOD, INDEED.—Yes; one was taken out May 17, 1883, a very fine fish. It weighed 7 pounds less 1 ounce, and measured 22 inches. It was baked, and pronounced very good, indeed, by all who ate of it.—JAMES BAYLISS, *Massillon, Ohio.*

42. VERY GOOD, INDEED.—Yes; fried. They are very good, indeed.—W. B. CHAPMAN, *Macon, Ga.*

43. HIGHLY ESTEEMED.—I have not; but hear of some that have, and that they are highly esteemed.—SHOTWELL POWELL, *Keysville, Va.*

44. WELL PLEASED.—We ate one, baked, that got caught in the chute. We were well pleased with the edible qualities.—A. H. BAKER & CO., *Fairfield, Ill.*

45. HIGHLY PLEASED.—We ate two. They were fried. We were highly pleased.—LOWREY & BERRY, *Blue Mountain, Miss.*

46. GOOD AND RICH.—We broiled two, and found them of good flavor, fat, and rich.—GEO. N. FALK, *Lenoir, N. C.*

47. JUICY AND GOOD.—We ate three fried, and all were well pleased. They were juicy and good.—W. N. REEVES, *Eufaula, Ala.*

48. RICH, JUICY, BUT NOT DELICATE.—I have eaten about 3 or 4 fried. It is a good pan-fish, rich and juicy, but flesh not delicate.—I. RANDOLPH MORDECAI, *Baltimore, Md.*

49. DELICATE, WHITE, AND VERY NICE.—They are solid, delicate white meat, and very nice. They were fried.—JNO. R. BROWN, *Woodstock, Md.*

50. VERY NICE.—I ate one fried that weighed about 8 pounds, and it was very nice.—THOS. LONGBOTHAM, *Wortham, Tex.*

51. VERY NICE.—We have cooked them two or three ways, and find that the larger ones are very nice.—O. A. GILMAN, *Paris, Ky.*

52. VERY NICE.—I ate two of them fried; they are very nice.—JOHN HEETER, *Hunting Hill, Md.*

53. VERY TOOTHSOME.—Yes; fried; and pronounced as very toothsome by all who had the pleasure of partaking of them.—JACOB G. HEILMAN, *Jonestown, Pa.*

54. VERY FINE BAKED; GOOD FRIED.—I have eaten three that were caught while fishing with hook for other fish and wounded in the mouth. We baked one three-pounder. It was very fine; flesh firm; good flavor. We fried one of 2¼ pounds. It was quite good.—JOHN G. KEITH, *Jackson, Tenn.*

55. VERY FINE, SWEET, AND RICH.—All report them very fine eating; very fat, sweet, rich, and toothsome when fried.—H. C. LOOSE, *Hagerstown, Md.*

56. THE DUTCHMAN SAID IT WAS FINE.—The one who proposed my getting carp suggested that I bring it to him and let him serve it up, as he knew all about it, and that I should dine with him. I consented. The carp was eaten. I was not told when, but the Dutchman said it was fine.—P. S. CLARKE, *Hempstead, Tex.*

57. FINE.—Yes, sir; and it was fine. It was fried.—J. N. THOMASON, *Paris, Tenn.*

58. FINE.—Have eaten them fried; weight, 4 and 10 pounds. They were pronounced by all to be a fine fish for the table.—Mrs. A. B. WATTS, *Newton, Miss.*

59. VERY FINE.—Yes; and very fine. They were fried.—W. H. SHIRLEY, *Harrisonville, Md.*

60. VERY FINE.—I ate two of them. I had them baked. Their edible qualities were very fine.—JAMES BUMGARDNER, SR., *Greenville, Va.*

61. VERY FINE.—I have eaten them baked and broiled. They are a very fine food fish.—THOMAS HUGHLETT, *Easton, Md.*

62. VERY FINE.—My wife caught one with her hands when I was from home. She pronounced it very fine. She fried it in lard.—J. A. DULA, *Lenoir, N. C.*

63. VERY FINE.—I ate one; baked it. The flavor was very fine.—C. W. ALEXANDER, *Charlotte, N. C.*

64. VERY FINE.—I have eaten several while some of my friends were participants. All pronounced them very fine cooked by frying in plenty of lard.—S. M. CLAYTON, *Cyruston, Tenn.*

65. VERY FINE.—They are very fine.—WM. ELLIOTT, *Taylor, Tex.*

66. VERY FINE.—Persons who have eaten them cooked in the ordinary way (fried) say they are very fine.—C. J. WATSON, *Munfordville, Ky.*

67. VERY FINE.—I have not. Those of my neighbors who have pronounced them very fine, either fried or boiled.—T. M. HIPNER, *Mortonsville, Ky.*

68. VERY FINE.—In my absence one of the oldest was caught with a hook. When landed the line parted, and the fish was injured so that

it could not be returned to the pond. It was fried and pronounced by the family very fine.—JAS. G. FIELD, *Gordonsville, Va.*

69. VERY FINE.—I ate two of them and found them a fish of very fine quality, much better than I anticipated.—F. S. EVERIST, *Port Deposit, Md.*

70. VERY FINE.—I have eaten a few. They were fried as we usually fry other fish. I found them very fine pan fish.—JOHN MCFADDEN, *Sudlersville, Md.*

71. VERY FINE.—The few eaten were fried, and were very fine food—remarkably good.—CHRISTOPHER & ROBERTS, *Fairburn, Ga.*

72. VERY FINE.—What fish I have taken from my pond to eat I have had baked and have found them very fine eating.—I. C. PLANT, *Macon, Ga.*

73. VERY FINE INDEED.—We ate only two. These were fried, and we considered them very fine indeed, and only wished we could have more.—H. L. SPENCER, *Social Circle, Ga.*

74. NUMBER ONE.—Yes, they were fried, and were thought by different persons to be No. 1.—THOMAS R. TULLOSS, *Rock Hill, Tenn.*

75. FIRST RATE.—I have, fried; first rate.—LEWIS BARLOW, *Sykesville, Md.*

76. FIRST RATE.—I have tasted three of the oldest. They were fried, and the quality was first rate.—J. M. BROOKS, *Waterford, Miss.*

77. FIRST CLASS.—My neighbors and myself ate one, after frying it as we would any other fish, and all unite with me in pronouncing it a first-class table fish.—GEORGE M. EMACK, *Versailles, Ky.*

78. FIRST CLASS.—Yes, fried. They are first class in every way.—J. A. LONG, *Yanceyville, N. C.*

79. FIRST CLASS.—Had one cooked. It was first class.—W. G. DELASHMUTT, *Martinsville, Ill.*

80. FIRST CLASS; WHITE AND FINE.—I caught two last year that weighed 5¾ lbs. We baked them, and regard them first class either baked or fried. The flesh is of a white texture, and fine.—A. SHINKLE, *Covington, Ky.*

81. EXTRA.—We have caught and eaten some fried, and claim them to be extra in quality.—S. O. HAWKINS, *Bucks, Ohio.*

82. GOOD ENOUGH; EXCELLENT.—Yes, a great many, both fried and baked. By our best judges carp is considered excellent. They are good enough. On account of their rapid growth and size they are better for baking.—GREENE B. MOBLEY, *Eutaw, Ala.*

83. EXCELLENT.—Yes, fried. They were pronounced excellent by every one who tasted them.—ABRAM E. NULL, *Union Bridge, Md.*

84. EXCELLENT.—Yes, one that was caught. It was fried, and considered excellent eating.—R. K. DABNEY, *Powhatan C. H., Va.*

85. EXCELLENT.—We have eaten one in April. It was pronounced by all a fish of excellent quality.—I. C. DONALDSON, *Gilbertsville, N. Y.*

86. EXCELLENT.—My partner ate one, and pronounced it excellent.—A. P. BROWN, *Jefferson, Tex.*

87. EXCELLENT.—We had them fried once; they were pronounced to be excellent.—J. W. SHIMWELL, *Prince Frederick, Md.*

88. EXCELLENT.—Four, fried. Taste excellent.—CHARLES SENSEMAN, *West Charleston, Ohio.*

89. EXCELLENT.—We ate two old fish and five young ones. Fried. Quality excellent.—GUSTIN HAVENS, *Lewis Center, Ohio.*

90. EXCELLENT.—Have eaten some and think them an excellent table fish.—HARRISON SUMMEROUR, *Warsaw, Ga.*

91. EXCELLENT.—Yes. Fried the young ones, and baked the old ones. Edible qualities were excellent.—W. M. THORNTON, *Lake, Miss.*

92. EXCELLENT.—One, fried, was excellent.—A. H. WILKINS, *Whitesborough, Tex.*

93. EXCELLENT.—Only one, which was fried. All who tasted it pronounced it excellent.—FRANCIS PRIDE, *Cedar Hill, Tenn.*

94. EXCELLENT.—In the summer of 1882, with hook and line, I caught three, one weighing 3½ pounds, the other two 2¼ and 2½ pounds, respectively. They were fried, and pronounced by the company to be "excellent."—JOSEPH LIGON, *Massie's Mills, Va.*

95. EXCELLENT.—Got surprised. Yes; broiled and they were excellent in flavor and consistency—much to my surprise.—R. EMORY, M. D., *Taylor, Md.*

96. EXCELLENT.—I have eaten carp in Europe frequently and found them an excellent pan-fish.—C. BOHN SLINGLUFF, *Towson, Md.*

97. EXCELLENT.—I have eaten none myself; but those caught in Hardware were said to be excellent fried and boiled.—HENRY M. PRINCE, M. D., *Scottsville, Va.*

98. EXCELLENT.—We had two cooked; one baked, the other fried. They were excellent.—EMANUEL HEYSER, *Madison, Ga.*

99. EXCELLENT; NOT GAMY NOR FISHY.—Yes, one. Baked and stuffed. The meat was white and of the consistency of shad. It had no game taste whatever and none of the fish taste. With condiments and being well cooked, all pronounced the dish excellent.—WM. E. SMITH, *Albany, Ga.*

100. SCALE CARP EXCELLENT.—Ate several fried. The scale carp I consider excellent. The leather carp not so good.—H. B. DAVIS, *Macon, Ga.*

101. EXCELLENT; SCALE CARP THE BEST.—I have eaten one of each variety and much prefer the scale carp to the leather. They were boiled and considered excellent.—A. W. OVERTON, *Frankfort, Ky.*

102. MOST EXCELLENT.—Have eaten one—fried it. Think it a most excellent table fish.—C. C. DAVID, *Harmony Grove, Ga.*

103. MOST EXCELLENT.—Mayor T. J. Jarratt had one of the carp baked and it was pronounced by himself and other members of the family and also by Capt. E. A. Goodwin, who was invited to partake of it, as a

most excellent fish. Mr. Coleman, the keeper of the Central Park, also speaks of it as very palatable.—*Petersburgh, Va., Index-Appeal*, August 12, 1882.

104. SPLENDID; NONE BETTER.—We have eaten some. We had them fried, and thought they were splendid. I don't think there could be any better fish.—JAMES W. OGLE, *Union Bridge, Md.*

105. SIMPLY SPLENDID.—Fried, and simply splendid.—M. S. GILMER, *Mathews, Ala.*

106. VERY SUPERIOR.—They are cooked according to fancy, as other varieties, and are very superior in flavor. As a baking fish they are very superior.—L. T. WHEELER, *Corsicana, Tex.*

107. SUPERB.—We ate one, which was superb.—PETER BONDS, *Harrisonburg, Va.*

108. SUPERIOR.—We have eaten a few of them and consider them a good eating fish. They were cooked the same as shad—fried. We look upon them as a superior fish.—JAMES HARBAN, *Dayton, Md.*

109. DELICIOUS.—Only once. They were fried in the usual way and were pronounced very palatable and delicious.—DANIEL WOLF, *Fairplay, Md.*

110. DELICIOUS.—Yes. They were fried and were delicious.—THOMAS V. RICHARDSON, *Phœnix, Md.*

111. DELICIOUS.—Fried; they were delicious.—J. M. WALLER, *Mexia, Tex.*

112. DELICIOUS.—Only one, weighing 3⅜ lbs., which was fried, and my family pronounced it delicious.—SAMUEL ANDERSON, *Rutland, Md.*

113. DELICIOUS.—Only upon one occasion, and fried. It was delicious.—J. W. DOWNEY, M. D., *Newmarket, Md.*

114. GOOD AS HE WANTS.—I have eaten 2 of the first lot merely to try them. The quality was as good as I want. They were only fried.—M. B. E. KLINE, *Broadway Depot, Va.*

115. FINE AS EVER TASTED.—I have eaten one and had it fried. It was as fine a flavored fish as I ever tasted.—W. K. HUNTER, *Rolesville, N. C.*

116. OILY AND FINEST FISH HE EVER ATE.—We have eaten nine and given away three. We fried them like other fish. They contained nearly oil enough to cook themselves and were very fine—finest I ever ate.—HENRY PULSE, *Harrisonburg, Va.*

117. NEVER ATE BETTER FISH.—One killed through mistake was fried, and we never ate a better fish.—ROBT. H. RICKS, *Rocky Mount, N. C.*

118. NEVER ATE BETTER FISH.—Have had them fried and don't think I ever ate any better fish in my life.—MRS. M. A. WALLACE, *Sherman, Tex.*

119. NEVER ATE BETTER FISH.—Have fried them, and never ate better fish.—WM. O. YAGER, *Luray, Va.*

120. BETTER THAN ANY OTHER FISH.—I have had three messes; one

last year, and two since. They were fried. They eat very well—better than any other fish in the country.—J. T. LOW, *Saulsbury, Tenn.*

121. VERY BEST.—We eat two large ones. They were broiled. The quality was of the very best.—Dr. SAMUEL HAPE, *Hapeville and Atlanta, Ga.*

122. BEST OF FISH.—I have eaten 5 or 6 weighing from 1 to 1½ lbs. each. We fried them in butter, and all who have partaken of them have pronounced them the best of fish.—MICHAEL WILLAX, *Baltimore, Md.*

123. BEST THEY EVER ATE.—We have eaten one which was fried. It was decidedly the best we ever ate. This was testified to by several. —JOHN C. WENGER, *Dayton, Va.*

124. BEST FISH HE EVER ATE.—Yes, they were broiled and were very nice—the best either of salt or of fresh water fish that I have ever eaten. —H. G. SANFORD, *Warren, R. I.*

125. BEST FISH THEY EVER DID EAT.—Yes, we used them all last summer, and gave a mess to all our friends and neighbors. All with one voice say they are the best fish they ever did eat, and we say so too. Cook them as you please. They are good enough for any man.—SAMUEL MCCLELLAND, *Salt Springs, Mo.*

126. NEVER ATE A SUPERIOR FISH.—In draining my pond's last year I caught a carp 18 inches long and had it fried. I never ate a superior fish. My family pronounced it excellent.—E. G. PEYTON, *Hazlehurst, Miss.*

127. SUPERIOR TO ANY OTHER FISH THERE.—We have eaten two which were fried. They were delightful and have superior qualities over any other fish here.—WM. L. HUDSON, *Luray, Va.*

128. FAR SUPERIOR TO ANY TEXAS FISH.—Yes, stewed and fried. They were splendid both ways, far superior to any Texas fish, in our estimation.—WILLIAM BRUEGGERHOFF, *Austin, Tex.*

129. GOOD AS ANY.—We have baked them and they are as good as any fish we ever ate.—J. SHAW MARGERUM, *Washington, Pa.*

130. EQUAL TO ANY FISH.—I have eaten some. They were fried and were an excellent table fish; equal to any species of fish.—WM. A. JETT, *Atlanta, Ga.*

131. EQUAL TO ANY FISH IN THE COUNTRY.—I have not, but several of my neighbors have and pronounce them equal to any fish in the country.—MONROE POINTER, *Como Depot, Ill.*

132. NICEST FISH EVER TASTED.—They are the nicest fish I ever tasted. We fried them the same as other fish.—WM. A. RIDGELY, *Glenwood, Md.*

133. FINEST FISH IN THE COUNTRY.—Have eaten none here, but plenty in Germany, and know it is the finest fish we have in our country.—WILLIAM RADAM, *Austin, Tex.*

134. NEVER ATE ANYTHING MORE DELICIOUS.—We ate the one 8 inches long, cooked with fine lard. I had visitors, and all joined in

saying they never had eaten anything more delicious. I know I never will.—JOHN HOUSTON, *Farmville, Va.*

135. MOST EXCELLENT FISH THEY EVER ATE.—I killed a dozen. My family and neighbors had them fried, and all pronounced them the most excellent of any fish they ever saw.—E. C. DICKINSON, *Rusk, Tex.*

136. A CRUCIAL TEST WITH MAGNIFICENT RESULTS.—Eight out of ten men with whom we have ever conversed about the table qualities of the German carp have affirmed that the fish was unsurpassable as an article of diet, but every now and then there comes along a ninth and tenth man who pronounces it coarse, dry, and not fit to eat. Our mind being thus unsettled on this great subject—and the present absorbing public interest in the carp culture demanding a dissipation of all doubts—we addressed a note to our old friend, Capt. A. D. Bates, of Batesburg, the pioneer of carp-raising in our county, begging that he allow us to spend a day with him and test the qualities of the carp. His reply was, "Come any day you please. Bring whomsoever you please. I shall be delighted, and you shall eat fried carp three times a day."

As regards the carp at dinner, it was in this wise: There were two dishes of them, 7 or 8 on each dish, fried. All these were in size from one to two pounds. They were fried as shad are. And certainly—and in all honesty and sincerity—we have never tasted a more delicious fish. So far from being dry, they are precisely the opposite; though as they grow older, the flesh becomes more solid. They have but few bones; the backbone and ribs, with but few besides. As we ate of the fish, the thought occurred to us that perhaps there was more in the cooking than in the fish. We intimated this thought to Mrs. Bates, who laughingly assured us that the frying process was of the very simplest, and that the fish were standing emphatically upon their own merits. In conclusion we beg to say that if our personal and individual experience of the table qualities of the German carp will be any encouragement to them in carp raising, we again affirm, without fear of successful contradiction, that the carp is an exceedingly delicious fish, and well worthy of any pains that may be bestowed upon it.—JAS. T. BACON and THOS. J. ADAMS, *Editors of the Edgefield Advertiser, Edgefield, S. C., March* 29, 1883.

III.—COMPARISONS WITH OTHER FISH—VERY GENERALLY COMPLIMENTARY.

137. GOOD; EQUAL TO BUFFALO.—Have eaten several that were fried. We consider their edible qualities good—equal to the buffalo in the Ohio River.—MATTHEW B. CARTER, *Shaker, Ohio.*

138. EQUAL TO BUFFALO.—We ate one, fried, which got caught in the ice and was killed. It was about as good as a buffalo, though if it had been fresh perhaps it would have been better.—G. W. VARNUM, *Montgomery City, Mo.*

139. EQUAL TO MULLET.—I have eaten 140 fried. I found them something like the mullet. They are very nice and sweeter than any other fish. Rather too sweet for some.—CHARLES J. RIDDLE, *Fork, Md.*

140. EQUAL TO BRANCH MULLET, OR SUCKERS.—Scale carp, first rate in quality. Leather carp, not so good, being more like the branch mullet or sucker.—BENJAMIN D. PALMER, *Sandy Spring, Md.*

141. EQUAL TO SUCKERS.—I have eaten only one. It was fried. I think it is about equal to our common sucker—fully as bony.—G. M. GALLASPY, *Decatur, Miss.*

142. EQUAL TO CATFISH.—A few days ago we ate two of the last lot, fried. They compared very well with ordinary fish—something similar to catfish.—P. PEYTON CARVER, *Mount Juliet, Tenn.*

143. EQUAL TO OTHER POND FISH.—Have not given them a fair trial, but think them equal to other lake fish.—I. A. EDMONDSON, 48 *South Calvert street, Baltimore, Md.*

144. EQUAL TO CROAKERS, MILL-ROACH, AND MUD-SHAD.—I have eaten some fried. I did not think they rated above croakers, mill-roach, or mud-shad. They had an earthy taste. I have never eaten them any other way than fried.—ANDREW REESE, *Lutherville, Md.*

145. EQUAL TO PERCH.—They eat very much like the perch that is found in our creeks and rivers.—JAMES T. BARTLET, *Trappe, Md.*

146. EQUAL TO PERCH.—Yes, they were fried and I thought them equal to our salt-water perch, which are good.—F. I. WILEY, *Charlotte Hall, Saint Mary's County, Maryland.*

147. EQUAL TO PERCH.—We have eaten some. They were fried and the flesh tasted similar to that of a perch.—GEORGE R. PARROTT, *Still Pond, Md.*

148. EQUAL TO ROCK FISH.—We have fried 12 or 15 of them and found them equal to pan rock.—JAMES BURTON, *Greenwood, Md.*

149. EQUAL TO DRUM BUT NOT TO PERCH OR BASS.—Yes, three. Two were fried and one boiled. They were eaten in the winter, and opinion was expressed that they were a good coarse fish, about equal to drum, inferior to perch or bass.—WILLIAM L. YOUNG, *Waverly, Miss.*

150. NOT EQUAL TO BASS.—Yes, very fair. They are not as good as bass. The flesh has not much flavor and is soft.—M. GILLET GILL, *Baltimore, Md.*

151. NOT EQUAL TO THE RIVER FISHES.—In April, 1882, I tasted of a baked carp weighing some 5 pounds, properly seasoned and cooked; I think it inferior to any of our running stream fishes for the table in flavor and texture.—IRA P. JONES, *Nashville, Tenn.*

152. QUITE SUPERIOR TO NATIVE FISH.—I have eaten two messes. They were fried and very fine; quite superior to our common fish.— J. C. KEITHLEY, *Shackleford, Saline County, Missouri.*

153. BETTER THAN PERCH OR CATFISH; NOT EQUAL TO BASS OR TROUT.—In June, 1882, I caught several estimated at one and a half pounds. All were returned to the water except two, which were baked

and eaten. They were considered as "good"; not so good as bass or mountain trout, but better than perch or catfish.—MATTHEW A. MILLER, *Richmond, Va.*

154. NOT EQUAL TO TROUT OR SHAD.—Yes, I had some prepared as fish generally are. My opinion is that they are the fish for the people, but not so good as the trout or shad.—C. M. COE, *Atlanta, Ga.*

155. NOT EQUAL TO TROUT.—I have eaten carp from another's pond. I liked them pretty well—not so well as trout. They were fried.—PEMBERTON WOOD, *Union Bridge, Md.*

156. NOT EQUAL TO TROUT OR PERCH.—I commenced in 1882, and have been eating on them ever since. I am getting old and could not wait any longer. We fry and stew them. They are very good, either way—not equal to the trout or perch.—M. S. FINCH, sr., *Wortham, Tex.*

157. NEXT TO TROUT AND PERCH.—Good; only surpassed by our native trout and perch.—E. L. MCGEHEE, *Woodville, Miss.*

158. BETTER THAN SUNFISH OR TROUT.—Fried, and better than the sunfish. I prefer them to the mountain trout from my pond near by or to my eastern trout bred here.—ADDISON BAKER, *Denver City, Colo.*

159. BETTER THAN RED-HORSE—NOT EQUAL TO BREAM.—One only—of the scaly variety. It was fried and pronounced fine—not equal to the bream, but better than red-horse, which it resembles.—S. W. BOOKHART, M. D., *Blythewood, S. C.*

160. EQUAL TO SHAD, RED-HORSE, BLACK BASS, OR SUCKERS.—They are equal to the shad, red-horse, black bass, white sucker, and other fish we get here.—ABEL A. WRIGHT, *Griffin, Ga.*

161. EQUAL TO ANY NATIVE FISHES.—Yes, fried. They are equal to any of our native fishes.—H. I. IRLY, *Eufaula, Ala.*

162. EQUAL TO BLACK BASS.—I think they are as good as black bass.—WM. DOWNEY, *New Market, Md.*

163. BETTER THAN BLACK BASS, ROCK OR MACKEREL—EQUAL TO SHAD.—We have, fried. We consider them equal to shad, superior to black bass, rock or mackerel, and we wish for nothing better. They are the fish for the million.—EDWIN H. REYNOLDS, *Rising Sun, Md.*

164. EQUAL TO BASS OR PERCH—SUPERIOR TO LAKE FISH.—The first one was caught about September 1, which we did not expect to be extra on account of the warm weather, but to our surprise it was excellent, and by one guest who is used to eating fish caught fresh from Lake Michgan and from different streams of this State, it was pronounced equal to the creek bass or perch, as it is sometimes called, which is considered the best fish we have, even superior to lake fish. We all thought it far better than catfish or suckers. It was not oily or coarse, as some papers have stated. Three persons besides our own family of four grown persons partook of it and all liked it. The other fish was caught in October after the weather became cooler, and four people, all different from the first party, besides our family, ate of it, the same opinion being expressed

as before. We who ate of both could see no difference, unless it was a very little more firmness to the flesh of the last.—GUSTIN HAVENS, *Lewis Centre, Ohio, April 6, 1883.*.

165. NEARLY EQUAL TO RED SNAPPER.—Have eaten no carp under 2 lbs., at which weight they are an excellent pan fish, only the flesh is a little soft. An 8 pounder baked is nearly as good as a red snapper.—B. J. WILSON, *Atlanta, Ga.*

166. NOT EQUAL TO SHAD—Yes, and I do not consider them first class for eating. They will not compare with shad and other fine fish in North Carolina, waters.—H. B. WRIGHT, *Saulsbury, Tenn.*

167. NOT EQUAL TO SHAD.—Yes—they were fried as we cook herring and their quality was fair, but not so good as Potomac shad.—ASA M. STABLER, *Spencerville, Md.*

168. EQUAL TO SHAD.—We ate one this morning. It was broiled. It was very good—something like shad.—WM. THOMPSON, jr., *Lemont, Pa.*

169. EQUAL TO SHAD.—I have. They are first rate, about equal to boiled shad.—SAMUEL T. EARLE, *Centreville, Md.*

170. EQUAL TO SHAD.—Yes, fried; most excellent, equal to shad.—IRA A. FITZ GERALD, *Linwood, N. C.*

171 EQUAL TO SHAD.—I cooked four during last year. They were fried as we usually prepare shad, and I consider them equal to shad.—RICHARD H. CORNEGYS, *Greensborough, Md.*

172. EQUAL TO TROUT OR SHAD.—Yes, baked and fried; fresh from the water. It was equal to trout, and I think equal to shad.—Dr. H. H. CARY, *La Grange, Ga.*

173. BETTER THAN SHAD.—We have eaten two fried and consider them better than shad.—WM. B. TEWELL, *Rockhill, S. C.*

174. BETTER THAN SHAD.—Yes, baked; superior to shad.—H. G. EVANS, *Hendersonville, N. C.*

175. BETTER THAN SHAD.—Two, baked. I found them an excellent table fish—in my estimation far superior to shad.—ADOLPH J. GALL, *Jessup's, Md.*

IV.—CRITICISMS AS TO SOFTNESS OR MUDDY TASTE.

176. GOOD, BUT A LITTLE SOFT.—We have eaten some few fried. They were good. Little on the soft order.—JOS. HAYGHE, *Upper Cross Roads, Md.*

177. SOFT.—The scale carp are best. The others are too fat and soft.—SAMUEL M. SUBERS, *Macon, Ga.*

178. SOFT.—We ate two, fried in butter. They were pleasant tasted, but the flesh was most too tender.—J. W. HIGBEE, *Castle Shannon, Pa.*

179. EXCELLENT, PERHAPS SOFT.—I ate two fried. Their table qualities were excellent. The first one was a little too fat and the meat a little soft.—C. C. LOBINGIER, *Braddock, Pa.*

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180. TOO SOFT.—I do not think them a good pan fish, being too soft. They are good boiled.—ROBERT E. WITHERS, *Wytheville, Va.*

181. SOFT AND OF A MUDDY TASTE IN JULY.—Cooked in lard. I did not like them. I found them to be soft and strong in flavor. I think it was July 8th that I tasted them.—WM. SALWAY, *Superintendent of Spring Grove Cemetery, Station A, Cincinnati, Ohio.*

182. SOFT AND OF A MUDDY TASTE.—I have eaten them fried several times. I do not like them very much. They are soft and taste a little muddy.—SAMUEL ROOP, *Westminster, Md.*

183. MUDDY TASTE.—I tried to eat a 3-pound scale carp, but found it strong, with a disagreeable muddy flavor. We fried and served it with spiced sauce. Some of mine are the leather variety, and perhaps they may prove better.—THOMAS CLAPHAM, *Roslyn, N. Y.*

184. A LITTLE MUDDY TASTE.—I have eaten some fried in lard that was fat, very good except a little musty taste.—ANDREW MANN, *Forest Hill, W. Va.*

185. MUDDY TASTE DUE TO POND.—The Albright mill pond was drawn off yesterday and Mr. J. E. McKnight gave us a small carp which we had cooked. The flesh was white and rather soft. The fish does not have many bones; but this one was not of fine flavor, having a muddy taste. This, however, may be owing to the character of the pond which is a very old one filled with red mud, and very offensive.—*The Daily Bugle, Jas. W. Albright, Editor, Greensboro', N. C., May* 2, 1883.

186. CAUSE OF MUDDY TASTE.—I have eaten them both fried and broiled. I think the scale carp superior to the leather, but the quality of the carp depends upon their food. If left to care for themselves they will taste of the mud.—L. TRIPLETT, jr., *Mount Jackson, Va.*

187. HOW TO AVOID MUDDY TASTE.—We ate a few last spring, fried. They tasted of mud unless they were first soaked in salt water. After being soaked over night they were very good. The meat is firm. What I used were scale carp.—Capt. JNO. T. FLETCHALL, *Poolesville, Md.*

188. SOME NOT GOOD, AND SOME VERY GOOD.—I ate 3 carp which weighed two pounds each. They were fried and I did not think much of them. The flesh was not very solid and had a sweet taste. Those eaten were in April before they had spawned, and while I and some of my family did not like them one of my neighbors, to whom I sent one, thought it very nice. These fish were some of the original lot received from you. I have this last week eaten some of the two-year olds weighing ¼ pound each and all liked them very much.—E. L. TSCHIFFELY, *Hunting Hill, Md.*

189. SOFT IN JUNE.—We baked a three-pound one taken from a very small and warm pond. We found it of good flavor, and sweet, but

very soft. It was killed late in June, and was full of roe.—LEONARD V. GREEN, *Norwich, Conn.*

190. NOT GOOD WHEN SPAWNING; OTHERWISE VERY FINE.—Only one, but about spawning season. It was strong tasted. I am assured, however, that they are very fine at other seasons, and even then if too young to spawn.—J. W. MEWBORN, *Macon, Tenn.*

191. NOT GOOD IN AUGUST; SMALL ONES VERY FAIR.—We have tried one weighing 10 pounds, and gave away others about that size. They were stuffed and baked. I think they are the poorest food-fish ever eaten. Even the smell is offensive. July 25, 1883.

The large carp I wrote about as being so offensive when cooked was served up in the month of August.

The small carp, say ½ pound to 1½ pounds, we catch with worms at the present time. The parties who have eaten them say they think them a very fair pan fish.—WILLIAM GRISWOLD, *Jobstown, N. J., July* 30, 1883.

192. RESULTS OF EATING CARP SOON AFTER SPAWNING TIME.—It must be remembered that the taste of mankind is so different that what would delight one would disgust another. We had a carp boiled by a German, but none of our party liked it thus cooked. The next was stuffed splendidly and baked. This was found more palatable. As a pan fish we must say that those fortunate people who know how a 13-inch freckle, such as you catch in Surrey and Sussex Counties, tastes will not take any stock in this new comer. But my opinion is that on a cold, frosty morning in October the carp will be found to be good eating, if properly cooked.—R. A. MARTIN, in the *Petersburgh, Va., Index-Appeal, August* 12, 1882.

193. DO NOT EAT CARP IN SPAWNING SEASON.—Last November one gentleman got a carp 20 inches long, and all who ate of it said it was O. K. Two others tried one, each in spawning season, and said they were not good. Of course these persons knew nothing of carp culture.—S. J. ALEXANDER, *Macon, Tenn., July* 3, 1883.

194. INFERIOR AND SICKENING AFTER TWO WEEKS' CONFINEMENT IN A RAILROAD TANK.—It was in the months of December and February that I tasted the carp. On one occasion I caught four out of my pond and put them in a railroad tank containing some 5,000 gallons of water which was changing every day or so. I put them in there, not for the purpose of changing their condition or edible qualities, but I was expecting a friend who was thinking of getting some, and I wanted him to taste them. I put them in the tank so that I could take a net and get them at any minute. But my friend did not come at the time I expected him and the carp *remained in the tank over two weeks*, being fed in the meantime on bread alone. This tank is a large wooden tub containing over 5,000 gallons of water. I served the carp in three different ways for the table, and in all the different ways it still retained its muddy, strong, fishy, sweet, sickening taste. Three out of four who

ate any complained of a little sickness at the stomach after eating them. After trying myself I sent a half dozen or more to friends in the village, and every one who ate them said it had the same taste to them as above. I must say I think it the most inferior fish I ever ate. I tried hard to see if I could not overcome some of my bad opinions of the fish, as I had gone to the expense of fitting up a nice pond especially for them, but facts are stubborn things. I am now stocking my pond with black bass in order that they may eat up the young carp, as I think them worthless for anything else.—COPELAND D. EPES, *Nottoway C. H., Va.*

V.—THE ONLY UNCOMPLIMENTARY REPORTS ASIDE FROM THOSE KNOWN TO BE DUE TO EATING CARP IN THE WRONG SEASON.

195. RATHER INDIFFERENT.—Have eaten several fried and considered them rather indifferent.—ROBERT M. STABLER, *Spencerville, Md.*

196. NOTHING EXTRA.—I ate two of them; I thought them nothing extra.—J. L. WOOLFOLK, *Madisonville, Ky.*

197. OPINIONS DIFFER.—Have eaten a number of them; most of persons pronounce them fine, others differ.—W. W. TUNIS & BRO., *Tunis Mills, Md.*

198. COULD NOT TELL.—We have fried and eaten two of the fish that we found in the grass with some hook holes through their mouths. Thieves had dropped them. We could not tell much about the quality.—JOHN B. BROWN, *Nashville, Ohio.*

199. UNFAVORABLE.—Opinion not in favor of carp.—JOHN COLLINS, *Bernardsville, N. J.*

200. VERY POOR.—I have. They were fried in hogs' lard. Their edible quantities were very poor.—JOSIAH PERRY, *Covington, Ga.*

201. DOES NOT LIKE THEM AT ALL.—We have eaten them several times, always fried in butter or lard, after being rolled in meal. I do not like them at all.—OSCAR REID, *Ferguson, Mo.*

202. UNFIT TO EAT.—Have eaten one and pronounced it decidedly unfit for table use.—R. PAYNE, *Georgetown, Ky.*,

203. WORTHLESS FOR EATING.—Yes, have eaten a few, baked, fried, and broiled. Their edible qualities are not good. I was very much disappointed in them. They are worthless for eating. I think it very likely that the muddy bottom of the pond causes the fish to be so indifferent for eating.—E. F. RAWORTH, *Vicksburg, Miss.*

204. TOUGH AND UNFIT TO EAT.—Our country is getting pretty thoroughly stocked with German carp, and there is hardly a paper in the land but teems with praises of their wonderful growth, loveliness, adaptability to the shallow ponds, &c., all of which we most unqualifiedly indorse; but how seldom do we hear one word as to their eating qualities. Although our esteemed senator from this district, who introduced them here three years ago, tells us they sell "side by side" with the best fish in the Washington, D. C., market, still that does not keep other

Kentuckians, at least, from having their tastes. From fifteen to twenty families around here have tried them at different times during the past year, and, except two persons who could eat them but didn't relish them, they unhesitatingly pronounced them unfit to eat. They have tried them boiled, baked, and fried, and discarded them every way. One lady says, they are well named leather carp, for we would prefer leather served in any style, to them; and, right here, might not our fish commissioners have mistaken their use, and ought we not to send a few to the tannery? Another person says he intends to keep raising them, for he knows they will prove valuable for soap grease. Such are some of their indorsements here, and we would like for others throughout the country not to think so much of them as we did, having them nearly three years before trying them, but to try them as soon as possible, and report the results.—*An anonymous Kentucky correspondent of the American Field, January* 20, 1883.

VI.—A FEW OPINIONS IN REGARD TO THE BONES.

205. VERY FREE FROM BONES.—Very much like Lake Michigan white-fish; bony at the back of the head, like shad. The remainder is very free from bones.—E. MILLER, *Mahwah, N. J.*

206. VERY FEW BONES.—Fried, it was very good—very few bones.—T. HOLT, *Holt's Summit, Mo.*

207. FINE FLAVOR, NO BONES, AND FAT.—Yes; dam broke, and those injured in catching were baked and fried. They were of fine flavor, fat, and no bones.—ED. M. GRESHAM, *Carlton's Store, Va.*

208. GOOD BUT BONY.—Yes; a good number fried and boiled. They are pronounced by all as good as any fish, excepting a few more bones than we usually find in other fish.—M. S. O'NEAL and C. G. ARNOLD, *Versailles, Ky.*

209. BONY, LIKE BUFFALO.—I dissected two or three and I found those detached bones that make the buffalo (Western Cyprinidæ) thick-lip so objectionable. Otherwise it is a good fish in August and September. After that they get soft and continue to be so till after they have spawned in June.—E. Z. BUTCHER, *Solomon City, Kans.*

210. BONES IN SMALL ONES.—Yes. Fine baking fish. Small ones are rather too bony for frying, perhaps.—E. A. LINDSEY, *Jackson, Tenn.*

211. NOT FULL OF BONES NOR MUDDY.—Carp are not full of bones and do not taste of mud as some would have us think, but, on the contrary, are very free from small bones and are a most excellent table fish, to which several who have dined with me will testify.—H. B. DAVIS, *Macon, Ga.*

VII.—HINTS UPON VARIOUS WAYS OF COOKING CARP BY OTHER ADMIRERS OF THIS FISH.

212. FRIED BROWN: FIRST RATE.—Yes; we have tried them three times. We scald them the same as catfish, roll them in meal, and fry

them brown. We think they are first rate; good as we want.—A. J. and W. B. BAIRD, *Nashville, Tenn.*

213. SALTED TO REMOVE MUDDY TASTE; THEN FRIED.—They tasted of mud unless they were first soaked in salt water over night. Then fried they were very good.—Capt. JOHN T. FLETCHALL, *Poolesville, Md.*

214. SALTED AND FRIED BROWN: EXCELLENT.—We took one out of pond No. 2, in May, 1883, weighing three pounds. When scaled, salted five hours, floured, and fried brown, it was of excellent flavor.—J. W. LONG, *Mount Morris, Pa.*

215. FRIED BROWN: VERY SUPERIOR.—I have eaten one. I pronounce it splendid. It is a very superior fish when well cooked and fried brown, as a fish ought to be.—EDWARD THOMPSON, *Saint Johnland, N. Y.*

216. BEST WHEN FRIED BROWN.—Some 25 or 30 persons in this vicinity have eaten them and generally pronounced them good enough. I ate two that were boiled and did not like them so well as fried and well browned. They are drier and suit my taste better.—W. E. LOGAN, *Andrews, Ohio.*

217. SPLIT AND FRIED: EXCELLENT.—We have tasted of the large size, and of the largest size of young ones. We had them fried. The large size were split before frying, and pronounced by my family and friends that helped to eat them excellent.—BENJAMIN G. CISSEL, *Highland, Md.*

218. SPLIT AND FRIED: NEVER ATE BETTER.—I have. The 1 to 2 pounds carp were split open and fried, and the opinion of every one is that they never ate better fish. Mine are of the scaly variety.—P. G. POWELL, *Versailles, Ky.*

219. FRIED IN BUTTER: NICE.—We have eaten one; cleaned it in the evening, salted it, and fried it in butter; thought it good and nice.—WM. SADLER, *New Salem, W. Va.*

220. FRIED IN BUTTER AND LARD.—Of the very finest. One, which was rolled in wheat flour and fried in butter and lard. Their eatable qualities were of the very finest.—BENJAMIN L. GARBER, *Marietta, Pa.*

221. FRIED IN LARD: EXCEEDINGLY GOOD.—Last October we ate two of the smaller ones. They were fried in lard, as fresh fish are often cooked, and all who tasted them pronounced them exceedingly good.—DAVID SCOTT, *Elkton, Md.*

222. FRIED IN LARD AND OIL.—Yes, sir; fried in lard and cotton-seed oil; we prefer the oil. We think they are a very fine fish and very sweet.—E. B. PLUNKET, *Atlanta, Ga.*

223 SLICED AND FRIED WITH EGGS AND CRUMBS.—The only one eaten was cut into steaks, dipped into egg and bread crumbs, and fried. The quality was good.—JOHN PICKERING, *Fontana, Kans.*

224. FRIED AND BOILED: GOOD.—We have eaten and presented to our neighbors about 100, and all regard their edible quality good.

We fry them and boil them same as rock fish.—JOHN S. DALLAM, *Bel Air, Md.*

225. BROILED: FIRST RATE.—Yes; broiled, with butter and pepper, they are first rate.—SAMUEL T. EARLE, *Centreville, Md.*

226. BROILED WITH LEMON SAUCE: DELICIOUS.—Yes; broiled, with lemon sauce, and baked, they are delicious.—P. H. COLEMAN, *Union Springs, Ala.*

227. BAKED OR FRIED.—Last fall we ate two mirror carp, and the 7th of August, 1883, two weighing 4 pounds and one ounce. One was stuffed and roasted, the other fried. A. Stout, Dr. Terry, S. Sharp, John Bidger, and others join me in saying they are the best they ever tasted. About twenty persons tried them on my fifty-sixth birthday. —Dr. SETH G. BIGELOW, *Silver Lake, Ind.*

228. SKIN, AND FRY OR BAKE THEM.—We first skin them, then thoroughly scald them and either fry or bake them.—O. A. GILMAN, *Paris, Ky.*

229. EATS THEM VARIOUS WAYS.—I have eaten them abroad in various styles of cooking, but have eaten none of mine.—DANIEL C. BIRDSALL, *Westport, Conn.*

230. ALL WAYS: VERY EDIBLE; SCALE-CARP BEST.—I have eaten quite a number fried, baked, stewed, and boiled. When properly prepared they are very edible.—SAMUEL M. SUBERS, *Macon, Ga.*

231. ALL WAYS: EQUAL TO SHAD.—Baked, boiled, stuffed, fried, served on rice, eggs, toast, &c., they are equal to shad.—ABEL A. WRIGHT, *Griffin, Ga.*

232. ALL WAYS, BUT LARGE ONES ARE BEST BOILED.—Yes; boiled baked, boiled, and fried. They are best boiled when large.—BENJAMIN D. PALMER, *Sandy Springs, Md.*

233. PREFERS THEM BOILED.—Have been eating them all summer, broiled, fried, and boiled. Boiled is thought the best with us and by others that have eaten them.—Capt. E. HERMAN, jr., *Towson, Md.*

234. BOILED LIKE ROCK: GOOD.—Yes; fried and boiled. The larger carp boiled and served as rock are served is palatable and good.—ROBERT E. WITHERS, *Wytheville, Va.*

235. A GERMAN METHOD.—It was with no common pleasure that we were called on to witness the preparations for an original and savory meal, which the forester of Max von dem Borne [of Berneuchen, Germany] cooked with consummate skill, closely following the method employed by the North American trappers and sportsmen during their camp-life in the vast forests of the Western Hemisphere. Four plump carp were cleaned, washed, well strewed with salt and pepper both on the inside and the outside, and thereupon wrapped—each one separately—in a white sheet of paper well buttered. Round this a sheet of newspaper was wrapped, the package was for a few moments dipped in cold water, and finally placed on a bed of hot coals of an open fire. Above the four carp came a layer of raw potatoes, which were thus baked in

the ashes. In about half an hour the "pepper carps" were ready for the table. Full of their own juice, they formed a most tempting and delicious dish, and being handed round, together with potatoes, on large napkins, satisfied even the most epicurean taste. [From the Magdeburgische Zeitung, No. 501, Magdeburg, October 27, 1881.]

236. GERMAN METHOD OF COOKING.—Yes; many a one in Germany. When young, say 2 to 3 pounds, they will do to fry; but when they weigh 10 to 50 pounds they are generally stewed in water first, afterwards in a gravy made of brown bread, a small portion of sugar or of molasses is added, and then they put in enough of brown beer to make gravy sufficient to cover the fish and also according to the size of the family.—LEO WELTZ, *Wilmington, Ohio.*

237. BOILED IN BEER: DELICIOUS.—Yes, sir; they were boiled in beer after the Saxon fashion (not lager beer, however, but what is called common beer). They were delicious.—HUGO MULERTT, *Cincinnati, Ohio.*

238. WINE METHOD OF COOKING.—I have eaten carp and find them good. One specimen of 5 pounds and two years old, taken from a pond on Long Island, was cooked as follows: First boiled in white wine for 15 minutes and then baked in an oven and served with a white-wine sauce. It was eaten by a number of epicures, and by all pronounced a fine table-fish.—EUGENE G. BLACKFORD, *Fulton Market, New York, N. Y.*

239. PARTLY BOILED AND PARTLY BAKED: FIT FOR A KING.—I always instruct the cook to clean them nicely; then wrap the fish in a linen towel, have a large kettle of water boiling, coil the fish neatly in the kettle and boil fifteen minutes, then turn off the water, remove to a baking pan without marring and put in the oven, bake and then baste with butter gravy. A nice dressing could occupy the interior of the fish and the space around the sides. If properly done it makes a dish fit for a king or a hungry fisherman.—W. VAN ANTWERP, *Mount Sterling, Montgomery County, Ky., October* 31, 1882.

240. SKINNED, DIPPED, AND FRIED: EXCELLENT.—The carp we caught from our pond last September to eat were skinned when dressed, cut into pieces of suitable size, dipped in flour, and fried. It was excellent.—GUSTIN HAVENS, *Lewis Centre, Ohio.*

241. BOILED; BUTTER GRAVY: RESEMBLED LOBSTER.—I ate but one carp, which was boiled and served with a butter gravy. A friend, who was taking dinner with me, as well as myself, pronounced, it "very good indeed" although different from any other fish, with a faint resemblance to lobster in taste. It is, however, not impossible that we both were prejudiced in favor of carp.—A. RAHT, *South Cottonwood, Salt Lake County, Utah, Feb.* 9, 1883.

242. AN EXCELLENT RECEIPT FOR FRYING CARP.—Be sure to clean the fish thoroughly. Remove the fat from the inside. Place the fish in a weak brine over night. Wipe it thoroughly dry and cover it with flour or meal. Have the fat boiling hot and do not put the fish in until it is boiling. Fry quickly, and brown as you like to have it.—Prof. E. T. COX, *New Harmony, Ind.*

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53.—THE SPAWNING OF BLUEFISH—AN OPINION OF THE CAUSE OF MORTALITY OF FISH IN THE GULF OF MEXICO.

By H. D. PIERCE.

[From a letter to Prof. S. F. Baird.]

I have repeatedly taken bluefish in Lake Worth, Florida, also at Jupiter Inlet, fully ripe and ready for spawning, in the month of January. In April, I have seen great numbers of young bluefish at the south end of Lake Worth. This is a salt-water lake, with no fresh water flowing into it of any account, and the only lake of the kind on the Florida coast. I have no doubt that it will be found that the bluefish spawn all along the Florida coast.

I do not believe the theory that the occasional mortality of the fish of the coast is caused by poisonous water coming from the Everglades. If the water in which these dead fish were found had been tested with a thermometer the reason would probably have been found. I once tried it by immersion and succeeded in giving myself the worst chill I ever had. The next day, for a distance of four miles, there were thousands of fish on the beach all floating in the water. All were what we call bottom or rock fish with one exception, the flying fish, of which a great many were killed. This was in the month of July, when there was no fresh water coming out of the Everglades within 60 miles of where the fish were found.

BISCAYNE BAY LIFE SAVING STATION,
Miami, Fla., August 31, 1883.

54.—THE GERMAN CARP AND ITS INTRODUCTION IN THE UNITED STATES.

By CHAS. W. SMILEY.

[A paper read before the American Association for the Advancement of Science, at the Minneapolis meeting, 1883.]

1. SYSTEMATIC POSITION, VARIETIES, AND ECONOMIC RELATIONS.—The German carp belongs to the family *Cyprinidæ*, and genus *Cyprinus*. Of the *Cyprinus carpio* there are three varieties: the scaled, which is the most edible; the leather, which is the most prolific; and the mirror, which is intermediate between the other two. The common gold-fish, *Cyprinus auratus* Linnæus, is an allied species, with which the German carp very readily hybridizes.

The present purpose is not to speak of carp from a biological standpoint, but from an economic one, especially as there is little that is new with reference to its biology and much that is new when economically considered.

2. HISTORY OF ITS INTRODUCTION.—The carp was originally from Central Asia, whence it was introduced into Europe a few centuries ago: into England in 1504, and into Austria in 1227. It is alleged that Capt. Henry Robinson brought carp from Holland to the United States about 1830 and put them into his ponds at Newburg, N. Y., from whence they escaped into the Hudson.* As nothing practical came of this, the real introduction of carp into the United States dates from May 26, 1877, at which date Mr. Rud. Hessel arrived from Bremen with 345 carp of different varieties for the United States Fish Commission.† These were propagated under the direction of Prof. S. F. Baird. The distribution of their young commenced in the fall of 1879, and has continued to the present time in increasing quantities annually. The number distributed in 1879 was 6,203 to 273 applicants in 24 different States of the Union. In 1880, 31,443 were distributed to 1,374 different applicants in 34 different States and Territories. During the past season 113,605 have been distributed in lots of from 15 to 20 to each applicant.

3. NATURAL HISTORY.—The carp prefers a pond containing warm water and muddy bottom, but neither of these are absolutely essential. It feeds upon such worms and lower forms of animal life as are within its reach, but never upon other fishes. It will, however, eat its own eggs if forced to by hunger. It is very fond of vegetable food, such as lettuce, cabbage, leaves of various water plants, seeds, grain, meal, bread, crackers, corn-bread, &c. Most anything you would give to chickens you can give to carp to eat.

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* See Bulletin of the United States Fish Commission, 1882, page 25.

† Report of United States Fish Commissioner for 1877, page 43.

If the water is warm, the summer long, and there be plenty of food, either natural or artificial, the growth of the carp will be surprisingly rapid. There are well authenticated reports of it reaching 3 pounds in one year and 6 pounds in two years. If no artificial food is furnished, and there is also a scarcity of natural food, or if the climate be cold, the growth will be much less rapid. Indeed, when the water becomes quite cold it will partially bury itself in mud and lie in a dormant state through the entire winter and until spring fairly sets in. In the southern part of Texas it is probable that the carp will not be forced to hibernate at all except in case of an unusually severe winter. In the northern parts of Maine and Minnesota it may be expected to hibernate nearly half the year. As it cannot grow during its hibernation it is easy to see why so much more rapid growth is obtained in Texas than in Vermont. There is little danger, however, of it freezing to death, for carp have survived in tubs of water over which a thick film of ice has accumulated.

Carp usually spawn in cool latitudes the third year, in temperate latitudes the second year, and there are well authenticated instances of its having spawned in Southern Texas at the age of one year. These cases, however, are where carp are supplied with an abundance of food, well cared for, and protected from their numerous enemies.

The enemies of carp are legion, and in many cases exterminate the fish. Not only do all kinds of carniverous fish prey upon its young, but nearly all kinds of fish will eat its eggs. Frogs, snakes, and turtles will eat both eggs and young in numerous quantities. A snake was recently killed at the carp ponds in Washington in which was found over 25 young carp and numerous undigested skeletons of the same fish. One medium size snake, if furnished the proper facilities, can be depended upon to eat 40 carp per day, one thousand per month, or five thousand each summer. Divide your number of young carp by this figure and you can find out how many snakes it will require to exterminate your young. Various birds, such as kingfishers, bitterns, cranes, herons, and fish-hawks understand catching carp much better than the average farmer. About the 17th of July last a marsh hen was shot at the Washington carp ponds whose stomach contained 38 young carp, and a night heron whose stomach contained the heads of 78 young carp. In many cases where the carp have been left to the mercies of these enemies they have succumbed. The only proper method is to furnish protection to the carp until they reach such an age as to be well able to cope with these enemies. It is therefore best to separate the spawning carp from all other animals, and carefully protect the eggs of the young for as long a time as convenient.

In regard to the food qualities of carp, it ranks somewhat above the ordinary native fish, such as buffalo, mullet, suckers, mud-fish, croakers, mill-roach, perch, sunfish, &c., but it is hardly equal to the high-priced delicate class of fish which includes the bass, trout, and shad. And

yet many persons who are cultivating carp declare them equal to any fish they ever tasted. If carp are grown in muddy or polluted water their flesh, like that of any other animal, will be impregnated thereby. But the carp may be removed to pure water for a week during which the system will be purified, and at the end of which even these will be good eating. Some have alleged that salting such over night will greatly improve the flavor. During and immediately after the spawning season adult carp, like all other fish, become soft and unfit to eat. Some persons have ignorantly tasted of them at this season, and have therefrom very unjustly condemned them. Carp contain bones, of course, but in the adult the flesh flakes off from the bones very nicely. Even in the small ones the bones are no more objectionable than in the average fish.

4. THE METHOD OF DISTRIBUTION.—Several breeding ponds have been fitted up at Washington from the so-called Babcock lakes and from extensions into the Potomac marshes. These will present a very picturesque appearance, in addition to their usefulness, after the reclamation of the Potomac flats. These ponds are constantly watched by their superintendent, Mr. Rud. Hessel and his assistants, who have abundant facilities for destroying enemies, draining the ponds, supplying fresh water, food &c. At the proper season, which extends from October 15 to January or February, the young are sent out by one of two methods: first, they are put in five and ten gallon cans of water and loaded in the cars of the Fish Commission, of which there are two fitted up with suitable appliances for carrying all kinds of fish. These cars, which present an outward appearance of parlor cars, are dispatched on passenger trains to central points in all the different States of the Union, where installments may be delivered to State fish commissioners or the carp treated by the second method. Second, a quart pail containing a pint of water and 15 to 20 carp can be sent by express to any distance which will not require more than 36 to 48 hours, or even further, if the water can be changed meantime, always provided that water enough remains in the pail to cover the backs of the fish. Most of the States of the Union have appointed State commissioners, who receive installments from the United States Fish Commission and distribute them to applicants within their jurisdiction. Many of them have also established propagating ponds, in which they are already producing young by the thousands and tens of thousands. Some private speculators have received carp from the United States Fish Commission, reared young, and are now selling them at speculative rates. The price list of one of these gentlemen states that he will sell mirror carp ten months old at $75 per hundred, scale carp ten months old, at $70 per hundred. Large fish are even sold at five dollars a pair, and would perhaps be sold at higher rates were it not for the fact that the United States Fish Commission furnishes its small fish free of cost. The express charges constitute the only expense to the recipient.

5. ECONOMIC RESULTS.—The cultivation of fish is destined to become as important among the American farmers and planters as the cultivation of cattle, sheep, swine, poultry, or of grains, fruits, and berries. They have long since ceased to leave the latter to shift for themselves and to cope with their enemies, knowing that in such a struggle live stock, grains, and fruits come off second best or succumb. Fish should receive the same care and attention, both as to improving varieties, artificial propagation and growth. The practice which farmers will obtain in carp culture will probably open the way to the successful culture of various other kinds of fish. The hardiness and wide range of diet and the rapid growth of carp especially fit it to be the precursor in fish farming. Every rural community is destined to have its fish ponds in the same abundance that it has its pig pens or its poultry yards. This will enable every farmer, however remote from market, to introduce fresh fish into his bill of fare at a very trifling cost. The carp may be made a pleasurable pet, learning to come to its food at call, if habitually fed in one place, and in shallow water, or upon a plank submerged a few inches. From these places, by reason of its tameness, it can be taken even with the hands. Finally, there is no more tasteful and economic means of decorating a plantation or a country seat than by a carp pond neatly prepared and protected. If, however, any persons should imagine that these good results are to be attained merely by filing an application for carp and upon the receipt of the fish leaving them to shift for themselves, and unaided to cope with their enemies, it is well that their minds be disabused at the first, for there is no provision of nature anywhere whereby a man shall obtain his daily bread except by the sweat of his brow.

UNITED STATES FISH COMMISSION, *August* 21, 1883.

55.—PROCESS OF PRESERVING FISH.

By RALPH S. JENNINGS.

[Patent No. 273,094, granted February 27, 1883.]

CLAIM.—The process, substantially as described, of treating salted fish for the destruction or killing of the alga germs contained in the salt of such fish, such process consisting in rapidly passing, at or about at a speed as hereinbefore mentioned, the fish over a sufficiently heated surface, or through or in contact with heated air or superheated steam, at or about a temperature of 400° Fahrenheit, so as to superficially heat the fish to an extent required to kill the said germs, without heating the interior of the fish to the injury thereof.

BALTIMORE, MD., *August* 10, 1882.

Vol. III, No. 22. Washington, D. C. Oct. 18, 1883.

56.—FISH-CULTURE AS SEEN AT THE LONDON EXHIBITION, WITH SPECIAL REFERENCES TO ITS HISTORY, APPARATUS, AND THE METHODS USED IN THE UNITED STATES.

By A. A. W. HUBRECHT.*

"Neglected" is an ugly word; wherever it is spoken, the idea of "neglect of duty" seems to be implied.† Whenever a public interest is referred to, such neglect of duty can only be laid to the charge of the Government. This does fortunately not yet apply to the subject of which I am going to treat. The Government of the Netherlands has for a long number of years taken a lively interest in everything relating to our fisheries. Many measures taken by our Government show that it has at all times not only watched over the interests of our fisheries, but has also occupied itself with the question so intimately connected therewith, viz: Are our rivers, our inland waters, and the lakes along our coasts sufficiently supplied with fish; and, if not, how can the number of fish be increased? If there can be any question of neglect of a public interest, this can surely not be laid to the charge of our Government. Now, however, is the time to strain every nerve, if we desire to reap the fruits of the seed which has been sown here and elsewhere, and not to allow ourselves to be outdone by others.

If any one wishes to be convinced that a great public interest of the Netherlands is in danger of being neglected, unless the matter is taken in hand speedily and energetically, let him this summer visit the International Fishery Exposition in London.

After having left the Exhibition road, you turn to the left, and, by paying a shilling, are privileged to enter the portals of this world's exposition, the seemingly endless hall extending before you, in which the British exhibitors have placed on exhibition innumerable models of ships and fishing apparatus.

About half-way up this hall you turn to the right, and you soon find yourself between the Netherlands' and the Danish exhibit. Whilst the former, with its large number of nets, gracefully arranged, immediately makes you feel that you are in a Fishery Exposition, the latter, through its Arctic colonies, represented by skins and fishing apparatus from the cold North, forms a suitable transition to the Newfoundland exhibit, where ice bergs and seal-hunting will engage your attention. Turning again to the right, and proceeding a few steps, you find yourself in that

* *Een verwaarloosd Volksbelang*, in a reprint from "de Gids," No. 7, Utrecht, 1883. Translated from the Dutch, by HERMAN JACOBSON.

† The title of this article in the original was "A neglected public interest."—EDITOR.

part of the Exhibition where I intended to lead you, and where I shall hold you for some time, viz, the exhibit of the United States. Here you find gathered, with astonishing completeness, everything relating to the fisheries of the Union. Do not ask me how much Congress appropriated to cover the expense of America's share in the great London Exposition; but if you should ask, and receive an answer, don't compare it with the amount which the Netherlands exhibit had at its disposal; or, rather, keep in mind the comparison between the two sums whenever you wish to compare the completeness of these two exhibits.

This, however, is not the principal object of our visit to this exhibit, and its tasteful arrangement must not cause us to forget the circumstance that, for the present, we only wish to become acquainted with a part of it, viz, that relating to fish-culture. Every one knows what this word means. But it may not be generally known that the first fish-culturist was a German, by the name of Jacobi, who lived from 1709 to 1784, and who, in the year 1765, published a work on the subject, which was the first of the numerous publications relating to fish-culture which have appeared since. "Breeding of fish," "artificial breeding of fish," these are two other terms for the same idea, viz, that of human aid extended to fish at the time when they propagate their species. This aid consists in accelerating the production of the eggs, in impregnating them, and in protecting both the eggs and the young fish during the first period of their development.

It is self-evident that under these circumstances a couple of fish can produce a much larger number of offspring than when they are left to themselves, when the eggs, from the moment they have been laid, are, on all sides, exposed to numerous dangers, from which they are protected by man's interference. Hence the term "artificial breeding of fish," which, however, is not well chosen, as the whole process of breeding and the development of the egg takes place in an entirely natural manner, human aid only being engaged in removing as much as possible everything that could hinder or injure this natural process. If for this more numerous offspring suitable natural conditions can be found, such as good water and good food, there is no doubt that, by a constant repetition of this experiment, the quantity of fish will be considerably increased, and consequently a larger supply of healthy human food will be furnished, and the interests of the fishing-trade will be furthered, if not by securing a larger revenue to the fishermen, at any rate by giving employment to a larger number of people. By a rational application of the rules of systematic fish-culture, the well-being of a country—provided it possesses a considerable area of water, and a large portion of the population is engaged in the fisheries—can be furthered rapidly and substantially. Opinions, however, may be divided as to the idea of rational application; and here we are met by one of the main questions relative to fish-culture as a public interest.

This will become very evident if we look round a little in the Ameri-

can exhibit, and compare it with the efforts in fish-culture made by other countries represented in the Exhibition. We shall very soon become impressed by the fact that whilst in Europe fish-culture, if not exclusively, at any rate principally, occupies itself with the *Salmonidæ* (salmon and trout), America also raises artificially other kinds of fish. We find that, besides the *Salmonidæ*, America raises, on a large scale, fish belonging to the *Clupeidæ* and the *Cyprinidæ*, and even codfish (*Gadidæ*). As regards the last-mentioned species, this seems almost incredible. Whenever I have taken the trouble to protect a codfish, when still in the egg, and as a young fish, I found that in that condition it was worthless for me, because, to make it grow as it should, it must return to its own element, the sea; and there to find him again at a later period seems just as hopeless as the desire of Polycrates that the waves of the ocean should return to him his golden ring! And still, correct as this reasoning may appear, the Americans will prove the whole thing to us, even if you should wish it, in dollars and cents; whilst the happy fishermen of Gloucester, Mass. would soon convince you of the contrary, if you were to tell them that their increased cod-fisheries were simply caused by accidental circumstances, and not by the energetic work of Prof. Spencer F. Baird and the United States Fish Commission.

The fact that such a conservative class of people as the fishermen have so soon become convinced of the favorable results of the artificial breeding of codfish, finds its very simple explanation in the circumstance that those codfish which from the very beginning have been experimented with belong to a gray variety, whilst so far almost exclusively reddish codfish were caught in those regions. The year following the first experiment numerous young codfish of the gray variety were caught; likwise in the following year, when they were considerably larger; and in the third year even the greatest doubters had become convinced. Satsifactory proof had been furnished that codfish placed in the sea either remain in the same region, or, *at any rate, return to the neighborhood where they had been originally placed by the fish-culturists.*

I have specially cited this example with the view of illustrating what in my opinion, is the proper meaning of the term "rational application." It takes the form of "care of the Government," "matter belonging to the Government," not of private initiative or private industry. I ask, what private individual would have furnished the money to place millions of young codfish in the sea? And if such a man had been found, his future heirs would justly have called him light-minded, and he would have run the risk of being placed under supervision of proper persons as being a spendthrift. But when the Government makes these experiments and makes practical application of the results of such experiments on a large scale, it encourages not only an important branch of industry, but the increase in the number of fish caught will prove a benefit to the general public. The chairman of the American division said to me, "In our country we would as little think of leaving

fish-culture to private effort as of taking from the hands of the Government the care of the light-houses."

Well said; but probably not very pleasant for the ears of true adherents of the Manchester school. These words should be taken to heart in Europe, and especially in the Netherlands; although it must not be forgotten, that with us the propagation of the salmon, which is strongly encouraged by the Government—also financially—is in good hands, and that four institutions rival each other in producing young salmon, which are, at the rate of half a million per annum, placed in our rivers. Where private efforts aided by the Government have already obtained such important results, it would not be advisable all of a sudden to place the whole matter under Government care. But we mentioned already that in the public interest, of which we are speaking, the salmon is only concerned to a limited extent. River fish like the shad, pond-fish like the carp, and sea-fish like the cod, are still waiting for the hands and brains of men willing and competent to increase their number tenfold.

It is in our immediate interest that such men be found in the Netherlands, so we may be the first to reap the fruits of America's teachings, and to take the front rank in the European fish markets which belongs to us, on account of our more numerous marine products, rather than to other countries which, owing to their nature and location are less favorably situated, and are not able to imitate the example set by America as well as we can. Let us briefly review the history and practical application of fish-culture in America:

Although as early as 1853 experiments in fish-culture were made in the United States by private individuals, the first public measure of importance was not taken till 1856, when the State of Massachusetts appointed three "fish commissioners." The question was not yet ready for solution. It was not till 1865 that the same State appointed a permanent Fishery Commission.

"Meanwhile an enterprising private individual, Mr. Seth Green, had, in 1864, succeeded in showing that fish-culture may be carried on in such a manner as to become a source of pecuniary profit; and in 1867—only sixteen years ago—the first piscicultural establishment in the United States was founded by the State of Massachusetts. Till the year 1870 various kinds of fish, especially shad and trout, were raised with constantly increasing success, the above-mentioned Seth Green taking the lead, and distinguishing himself, among the rest, by the invention of the "shad-box."

The year 1871 was doubtless the most important year in the history of American fish-culture; as that year was to witness the founding of two institutions, originally differing in their character and independent of each other, but later mutually aiding each other and thereby exercising a most beneficial influence on each other's activity. I refer to the "American Fish-culturist Association" (which in 1876

changed its name to the "American Fish-cultural Association"), and to the "United States Fish Commission." Of the nine Government institutions, which are either wholly or in part intended for making investigations on the field of pure and applied science, * the United States Commission of Fish and Fisheries is at this day, to quote the words of its historian, "*the most prominent of the present efforts of the Government in aid of aggressive biological research.*" Every person in Europe who has followed its career and who has studied its reports, will cheerfully subscribe to the truth of the words quoted above, which in such terse form expresses the deep interest which the Government of the Union takes in these researches; and we must not fail to mention that the energetic American mind did not only invent this term ("aggressive research"), but that it has also understood to make the aggression in such a manner as to conquer all opposition.

On the 9th February, 1871, a joint resolution of Congress authorized the Government to appoint a "Commisioner of Fish and Fisheries." Year by year it had became more evident that the Central Government must give the first impetus towards a new development of the fisheries. A person was already in view who by his learning and experience would be the man to be placed at the head of this new Commission. This person was Prof. Spencer F. Baird, the one who, at the Berlin Fishery Exposition, was awarded the great prize of honor which the Emperor of Germany has given for the best exhibit. The object for which he was appointed was indicated by the following: "to prosecute investigations on the subject of the diminution of valuable fishes with the view of ascertaining whether any and what diminution of the number of food fishes of the coasts and the lakes of the United States has taken place; and if so, to what causes the same is due; and also, whether any and what protective, prohibitive, or precautionary measures should be adopted in the premises, and to report upon the same to Congress."

It will be seen that in giving this charge fish-culture was not yet mentioned. Nothing was done in this direction until 1872, when representatives of the Fish-Cultural Association petitioned the Government to make the necessary appropriations for this purpose. Congress granted the petition. Every year this item is given in the appropriation bill, and the amount has been increased from year to year. At the same time fish-culture has occupied a place of constantly growing importance on the programme of the Fish Commission. More than a million dollars has, during the last twelve years, been appropriated by the Government of the Union, whilst the thirty-one States which had created Fish Com-

* These nine institutions are: (1) The Geological Survey; (2) the Coast and Geodetic Survey; (3) the Naval Observatory; (4) The National Museum; (5) the Department of Agriculture; (6) the Entomological Commission; (7) the Tenth Census; (8) the Smithsonian Bureau of Ethnology; (9.) the United States Commission of Fish and Fisheries; to which must be added, as an institution founded by aprivate individual, the Smithsonian Institution.

missions of their own appropriated sums for this purpose varying from $1,000 to $10,000.*

These figures will show sufficiently what pecuniary sacrifices the United States have cheerfully made in the interest of fish-culture; and we must now give some attention to the work of the Commission, which shows very important results.

In the first place it inaugurated a systematic investigation of the various rivers and water-courses of the United States, and of the physico-biological laws and problems which govern and relate to the life of fish in these waters. In making this investigation the Commission did not confine itself to those fish which are useful to man as food, but considered its task from a broader and more generally scientific point of view.

It devoted its attention alike to all inhabitants of the water; it gathered data for a natural history of all kinds of fish; it learned to know not only the fish themselves, but also their friends and enemies, their food, and the dangers threatening their life. At the same time it gave its attention to the food and the enemies of the various animals, both useful and hurtful, which share the water with the fish. Nor did the Commission fail to take note of the currents and their degree of swiftness, of the temperature of the water, and of many other physical conditions which exercise an important influence on the life and growth of most fish, and which doubtless have a good deal to do with the periodical migration which many kinds of fish undertake at certain seasons.†

In various ways a large collection of different fish and other marine animals was gathered, which formed an invaluable material for scientific investigations.

To aid the work of the Commission a steamship, the Albatross, was built, and which was first used by the Commission for studying the migrations of the mackerel, and the food and migrations of the herring. It has, moreover, now been resolved to establish a large and permanent zoological station at Wood's Holl, for which $25,000 have been appropriated.

In the second place the Commission devoted its attention towards obtaining the most accurate data relative to the different methods by which the fisheries are carried on, and to the history of the fisheries.

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* The following are the exact figures: New Hampshire, 1866–'79, $22,663; Vermont, 1871–'79, $7,880; Connecticut, 1868–'70, $43,300; Pennsylvania, 1873–'80, $99,030; Maine, 1867–'80, $36,975; New York, 1868–'79, $165,000; California, 1870–'79, $37,000; New Jersey, 1871–'80, $29,500; Rhode Island, 1870–'79, $10,500; Ohio, 1873–'80, $29,000; Wisconsin, 1873–'80, $38,800; Iowa, 1874–'80, $22,750; Minnesota, 1875–'80, $22,500; Kentucky, 1876–'80, $11,000; Kansas, 1877–'80, $2,000; Colorado; 1877–80, $2,400, Nevada, 1877–'80, $5,000; West Virginia, 1877–'80, $3,900. [Cf. p. 150.]

† At the instance of my honored colleague, Prof. Biujs. Ballot, director of the Meteorological Institute, observations have also been taken in the Netherlands, on board vessels which were engaged in the herring fisheries, relative to the influence which the temperature of the sea-water exercises on the migrations of the herring. These investigations, however, have been discontinued for a number of years.

This includes the gathering of extensive statistics relative to the fisheries and the fish trade.

In this way the Commission hopes to obtain an accurate knowledge of the influence which man is capable of exercising on the decrease or increase of fish; it also endeavors to make its work one of practical usefulness by directing attention to fishing-apparatus which threatens to cause the extinction of certain species of fish, and for which other, less hurtful apparatus might easily be substituted.

Recently Congress appropriated $60,000 for gathering these statistics. The report of these investigations comprises about 3,000 pages, with 700 to 800 engravings. Of this report 10,000 copies will be printed, and freely distributed in the most liberal manner. A total sum of $30,000 was appropriated for the publication of this work.

After having given some idea of the extent of the worth of this comparatively young American Fish Commission, and having anew assured our readers—as will become still further evident—that its work has borne rich fruit in all directions (which fact is also proved by the constantly increased appropriation annually made for this Commission), a comparison between America and the Netherlands—as regards activity in this field, may not be out of place. The Netherlands have possessed since the year 1857, and therefore for a period of more than twenty-five years, its Board of Sea-fisheries. This Board was exclusively an advisory body, advisory in the sense of directing the attention of the Government to existing abuses or defects. In other words, it took the initiative in all matters relating to the interests of the fisheries. Among the many important measures taken by the Government at the advice of this Board, confining ourselves to the most recent times, we will mention the abolition of the Government stamp on the herring-barrels, which caused a considerable increase in the quantity of herring exported from the Netherlands and the law of 1881 regulating the fisheries in the Zuyder Zee.

With regard to this last-mentioned law, whose practical advantages and disadvantages we will not discuss in this place, it would have been desirable to consult naturalists and profit from their knowledge and experience. In fact, the need was felt of a firm scientific basis for those rules and regulations which were to govern the fisheries. And for such a basis there was hardly any material whatever. It became evident that such material could not be obtained except by "aggressive biological research," and that not even a beginning had been made with the necessary investigations.

America, however, had set the example. Encouraged thereby the above-mentioned Board urged upon the Government the desirability of establishing a permanent zoological station at some place on the coast—best at Nieuwediep—with a permanent director and a changing staff of young and active assistants, for an exhaustive study of all the questions relating to our coast fisheries, with a view of drawing up reliable regu-

lations for governing these fisheries.* But alas the memorial of the Board did not meet with a favorable reception by the majority of the lower House of our Parliament. In spite of its being strongly advocated by Minister Klerch, many of the members could not see the direct use of such a measure (see the speeches by several members of the lower House), and in December, 1881, the motion, when put to the vote, was lost, 26 voting in favor, and 41 against it. Perhaps the time is near—and would that the London Fishery Exposition might hasten it—when the eyes of our representatives will be opened to the great importance to the welfare of our country of "aggressive research." Some energetic men, to take the matter in hand, and a liberal appropriation for carrying on the work would be the warm sunshine and the powerful fertilizer which would in a short time turn this barren field into a rich and productive one, thus proving a benefit to our entire country.

But even more than these investigations, the importance of the third part of the programme of the United States Fish Commission will be evident to any one who has given some attention to the subject; I mean the carrying on of fish-culture on a large scale, and by the Government. And of its importance I would like to convince all my readers. For this purpose I must give a more detailed description of the manner in which, in America, this "Government care" is exercised.

I will begin by mentioning some of the aids which have been furnished by the Government for attaining the object in view. In the first place a steamship of 600 tons has been furnished (besides the steamship of the Commission referred to above), costing $60,000, the officers and crew of which are furnished by the Navy Department, and whose duty it is to occupy themselves with the propagation of the shad in summer, of the codfish in winter, and of the mackerel in spring.

There is no better place for doing this work than such a floating workshop, more especially when we consider the great extent of the American coast line. Besides these steamships it became necessary to have railroad cars of a special construction. They were furnished at once, and at the present time live fish of different ages are safely conveyed throughout the whole vast territory of the United States. It is hardly necessary to state that these cars are of a special construction; nor will I here give a detailed description of the basins and various other contrivances for keeping the water fresh. All this can be studied at the London Exposition from excellent models.

After briefly mentioning these material aids, we must not forget to refer to the intellectual aid placed at the disposal of the Commission. Under the supervision of the Commissioner there is a full staff of experienced and skillful naturalists, which works into a whole all the various observations, and orders the new investigations called for by such observations. Their ranks are filled by young men who, after having completed their education at some college, desire to devote themselves

* See the Official Report on the Netherland Sea-fisheries, published in 1880.

to the science of zoology, more especially in a field where that science not only promises to supply many of the daily wants of the masses, but where it has already accomplished a great deal. They are the men who use for investigations in the field of embyology the exceedingly valuable scientific material furnished by the numerous stages of development of fish which may be observed in practical fish-culture. We may doubtless look for important communications relative to the results of these scientific investigations.

Round this staff of scientists there has gradually been formed an entire camp of officers who are thoroughly versed in the more mechanical work of fish-culture and fish transportation. The catching of mature fish, the impregnation of the eggs, the care of them during their development, and the raising of the young fish can only be intrusted to experienced persons, although a scientific education is not required for this work. It is self-evident that any one who desires to carry on fish-culture on a large scale must endeavor to obtain men who have had a good deal of practice in that line.

Let us now illustrate by two examples, the shad and the cod, what different methods and aids the Americans employ for reaching the great object in view, viz, a considerable increase of salable fish, cheap and wholesome food for the masses, and thereby an improvement in the condition of the common people.

As soon as the shad is ready for spawning, about the month of April, the officers in charge of propagation of this kind of fish go to those places where large numbers of shad are found. To these places the necessary apparatus is forwarded, and suitable locations are selected for carrying on the work.

The first object is to obtain mature fish of both sexes. These are caught exclusively by night. Thus there were, in 1878, from 82 shad obtained no less than 1,605,000 impregnated eggs. For the development of these eggs it is necessary that they remain in flowing water; and as they are heavier than the water, and therfore sink to the bottom, cone-shaped glass or metal funnels are used, into which the water enters from below through a narrow opening and flows out at the top through a gauze covering. Thus a very large number of eggs may be kept in a fresh condition within a comparatively small space, and may thus be safely developed. By a small modification of this apparatus the same current is used for separating the dead eggs and all impurities from the healthy eggs; while the latter remain near the bottom, the former are by the current carried towards the top and over the edge, and are thus easily removed.

In order to work a large number of eggs at the same time, Seth Green many years ago invented a so-called "shad-box," which he kept floating in the current, the water being freely admitted to the inside through the front, which is of gauze, and placed in a slanting position. This was doubtless a great improvement. In stormy weather, however,

these boxes, of which there were always several joined in a row, ran the risk of being hurt or upset, whilst they were useless in places where there was not much of a current, or, still worse, where the influence of the tide made itself felt, and where, therefore, for a certain time, there was no current passing through the boxes.

Major Ferguson has made an invention which not only obviates this difficulty, but which also enables the Americans to carry on shad-culture on a much larger scale and with the aid of steam-power. Briefly discribed, this invention is as follows: On the left and right side of a vessel, or raft, a large pole runs parallel with the sides of the vessel, from which are suspended a large number of buckets with gauze bottom. Their number may be increased as occasion requires. The poles, and with them the buckets, are moved up and down by means of a steam-engine placed in the vessel, or on the raft, in such a manner that the upward motion is slow and the downward motion rapid. In these buckets are placed the impregnated shad-eggs which are to be developed, and the upward and downward motion is regulated in such a manner that the buckets do not leave the water, but are not entirely submerged, which would endanger their contents or cause them to be lost. This can also be prevented by placing a gauze covering on the top of the buckets; if this is done the entire motion of the buckets may take place under the water, which sometimes becomes necessary, when the temperature near the surface is too low, and thus exercises a hurtful influence on the development of the eggs.

It will be seen at once that by this apparatus (1), shad-culture can, if necessary, be carried on in water where there is no current whatever, and (2), that this culture can be carried on on a much larger scale than could be done formerly. In 1879, or four years ago, no less than 16,062,000 young shad were distributed and placed in different rivers.

It should also be observed that the American shad (*Alosa sapidissima*) greatly excels, by its delicate flavor, our European shad (*Alosa vulgaris*), and is by gormands justly placed on the same line as the salmon.

After having given a short description of some of the apparatus employed in shad-culture, we will turn to the codfish. When, in 1878, codfish-culture was first begun, it was soon observed that the peculiar character of the codfish-eggs necessitated the invention of other apparatus; for whilst mature shad or salmon eggs sink towards the bottom, codfish-eggs are lighter than water and float, at a varying depth, near the surface. The apparatus which, after much experimenting, has been found to most satisfactorily answer the purpose, is also a row of buckets connected with each other by a pole, which are kept in motion by a steam-engine, but not up and down, but backwards and fowards, thereby giving to the buckets a swinging movement round their axis.

The extent of this swinging movement is about 90°. In these buckets there are four slits running lengthwise and covered with gauze; on the outside of each of these slits there is a slanting valve, as also under

the gauze bottom, only that here the valves are placed like sails. By this contrivance the motion given to the buckets by the steam-engine causes the water to rise continually and pass through the buckets with a screw-like movement, which of course keeps it fresh all the time and in a condition suitable for the development of the codfish-eggs. The result has amply proved the usefulness of this apparatus, for during the first year more than 70 per cent. of the eggs developed to young codfish, and no less than half a million were placed in the sea near Gloucester, Mass. I have already mentioned that these codfish, constantly increasing in weight and number, have been caught and brought into the market, and we may therefore consider codfish-culture in America established on a safe basis.

In what manner can the Netherlands derive the greatest possible benefit from the lessons taught by the American exhibit at the London Fishery Exposition? Certainly not by leaving fish-culture, in the future, principally in the hands of private individuals. In this way we may get a number of establishments which may be placed on a line with establishments for raising chickens and pigeons, but the public interest is not advanced thereby. For this purpose it is absolutely necessary, as has been mentioned above that the Government take the matter in hand and follow out a carefully prepared programme.

The first requirement, viz, numerous inland waters and rivers having suitable food for fish, we possess to an eminent degree. The carp, which, as the vegetarian among fish, would prove highly valuable in inland waters, the shad and the salmon in the rivers, and the codfish on the coast, are all fish whose adaptability to fish-culture has been fully proven. We have a large fishing population on our coasts; there is no need of seeking a market for our fish; and it will certainly be easier now than it was in former times to find young men of scientific education, competent and willing to do their share of furthering this important public interest. Men thoroughly conversant with the *technique* of fish-culture should be brought over from America, and teach some of our young men the practical part of fish-culture, so that they, in their turn, may be able to supervise and teach others this part of the work, which, though mainly consisting of manual labor is of the greatest importance for the ultimate success of the work.

It is not necessary, however, to begin everything at one and the same time, and to load down our budget during the very first years with a large appropriation for this purpose. The best plan would be, to make a beginning with carp and codfish; carp,* because they can be distributed throughout our entire country, as both Friesland and Groningen, Holland and Utrecht will be immediately benefited by their increase; and codfish, because our fishermen can easily obtain mature codfish,

* The carp of which we speak here, are the leather and mirror carp, and must be distinguished from the common carp already found in our waters. The former have a different shape and a much finer flavor.

since our coast waters seem to possess all the necessary conditions for the propagation of this fish and for its development; and finally, because for this culture one of our vessels could easily be prepared, thus avoiding, at least for the present, the necessity of building more costly apparatus on land. Such a vessel, if stationed at Nieuwediep, could certainly be employed under the most favorable conditions, because there are in that place many cod-fishermen and an abundance of excellent sea-water. If any one desires to study the construction and arrangements of such a vessel, he can do no better than visit the American exhibit in the London Fishery Exposition, where he will see excellent models of the American vessels and other apparatus employed in fish-culture.

I have mentioned above that as regards the salmon, whose culture—thanks to private enterprise—is in good hands in our country, it may for the present be left in these hands, thus freeing the Government from this responsibility.

I cannot conclude my article without once more directing attention to the circumstance that if we seriously think of having the third part of the programme of the American Commission, viz, the propagation of food-fish, placed in charge of our Government, we must by no means lose sight of the first and second part. With this view America has established a zoological station at Wood's Holl. Also in the Netherlands the establishment of such a station—much of whose work would prove of great benefit to the fisheries and fish-culture—would lead to a harmonious co-operation of science and practice, which could not fail to bear rich fruit and to increase the general well-being of our nation.

If after a number of years some one should again report on fish-culture in the Netherlands, let us hope that he will be able to present a different picture from mine, and give a glowing account of a public interest, no longer neglected, but advanced to such a degree as to prove a blessing to our entire country.

57.—AN ANALYSIS OF ARTESIAN WELL WATER FROM THE SHAD-HATCHING STATION AT HAVRE DE GRACE, MD.

By FRED. W. TAYLOR.

[Chemist of the Smithsonian Institution.]

An examination of the specimen of water from an artesian well at the Battery Station of the United States Fish Commission at Havre de Grace, Md., shows it to be heavily charged with iron, lime, and chlorides. Magnesia is also present in considerable quantity. The iron and lime are very heavy. Sulphuric acid is present only as a trace.

WASHINGTON, D. C., *June* 21, 1883.

58.—ON THE PROPRIETY OF DEPOSITING WHITEFISH MINNOWS OFF THE HARBOR OF CLEVELAND, OHIO.*

By FRANK N. CLARK and SEYMOUR BOWER.

It is no doubt true that whitefish seldom approach Cleveland Harbor. And yet it does not follow that the place is unfavorable to the early stages of whitefish life, if the minnows are set free in clear, deep water, wholly beyond the influence of sewage and refuse, as they were in the present instance. It is quite probable that the bottom in that vicinity is not at all adapted to spawning purposes, and that it furnishes only a very meager supply of crustacean food; hence but few adult whitefish are attracted to that locality. But these conditions are inimical to the requirements of the minnows, as the range and character of food demanded by the latter are widely at variance with the demands of the same individuals at partial maturity or adult life. The latter, in common with all sucker-mouth species, are bottom feeders, while the food of the minnows consists of minute organisms existing in the water. Now, it is claimed that the temperature of the water is a potent agency in the development of these organisms; that they are far more abundant at certain seasons of the year than at others; but manifestly it would be unreasonable to claim a like fluctuation for *localities* in a body of water like Lake Erie. One place is therefore as good as another, so far as the question of food for the young is concerned. It is also safe to say that the parent whitefish are powerless either to destroy or protect their young. Manifestly, then, neither the absence or presence of the adults nor their food and spawning requirements can be regarded as a factor in the problem of successfully planting the minnows in waters to which the species is indigenous.

Admitting that this is true, the question very naturally arises, what is the object of depositing the fish in different sections of the lake? Why not place them all at some point most conveniently approached from the hatchery, and thus save the expense and trouble of carrying them farther? This most certainly is the very plan that would be followed if multiplication of the fish were the sole object in view. But it is desirable not only to enrich the waters, but, in so doing, to create new fishing grounds for the most valuable food species; and new grounds cannot be created simply by restocking the old, even in a continuous body of water like Lake Erie. In such waters the only way to attain this object is to enlarge the migratory range by taking advantage of

*A million young whitefish which had been hatched by the United States Fish Commission at Northville, Mich., under the direction of Mr. Clark, were to be planted in Lake Erie. Mr. Clark was authorized to select the place and make the deposit. On page 302 will be found a protest against putting them in Cleveland Harbor, to which protest this article is a reply.—C. W. S.

that instinct which impels the adult fish to return, for the purpose of spawning, to the place where they were liberated in infancy. In a state of nature the minnows are released only from spawning beds; and the area of grounds adapted to spawning purposes is quite limited. But we are permitted to introduce the young at will, and thus establish new migratory routes on which they may be intercepted by the devices of man.

It is not at all probable that the parent fish will deposit their eggs in unsuitable places, though it is where they were first set free and they have returned for that purpose. It is far more likely that they will continue on the move until appropriate grounds are found. Some of the best whitefishing grounds of Lake Erie are neither spawning nor feeding grounds. We refer more particularly to the shore grounds between Sandusky, Ohio, and Monroe, Mich. Thousands of whitefish are taken here every fall from the runs setting toward the spawning beds of the Detroit River. Comparatively few ripe fish, however, are taken below Monroe; at Monroe the percentage of ripe fish is a little better; but the Detroit River is reached before the spawning has become general. The best spawning grounds of the lake are the island shoals between Sandusky and the Canada shore; and the runs thereto set in, apparently, direct from the deep waters lying eastward, and from the Canada shore.

The statement in reference to the abundance of saugers in the locality referred to by Dr. Sterling is substantially true; but the conclusion that in consequence "no other fish can exist" is manifestly at fault. Some other cause must be given for the scarcity of whitefish in that locality. Thousands of saugers are taken every fall from some of the best whitefishing grounds of the lake. From the spawning shoals around the Bass islands they are brought in with every lift during the spawning season of the whitefish, besides herring to the proportion of fifty herring to one whitefish. Again, in the spring, not far from the time the young whitefish are rising from the spawning beds, the saugers are even more numerous, to say nothing of the hundreds of basses and pikes that comprise the best part of the spring catch. It is safe to say that predatory fishes abound in greater numbers near these spawning beds, both at spawning time and soon after the fry are set free, if not continuously, than where the Cleveland plant was made. And yet the young whitefish are always set free, in a state of nature, in the very midst of these apparent dangers without diminution of the species.

It might be argued that the great fecundity of the species would more than offset these manifold dangers; but this, in turn, is more than offset by the fact that by far the greatest losses of all occur during the embryonic stage of development. Conferva, against which artificial manipulation alone is able to cope, is the fell destroyer—the octopus within whose grasp countless thousands of embryos annually perish. Only the comparatively few that are completely isolated can escape destruc

tion; so that but a very small percentage of the eggs deposited by the parent fish bring forth living minnows.

Nature has also accorded a very frail and feeble existence to the infancy of whitefish life. It would hardly seem possible that a single minnow could survive this period, were they pursued as prey by the thousands of predaceous fishes with which they must mingle upon rising from the spawning beds. Indeed, it may be stated without fear of successful contradiction that not only the whitefish minnows but those of many other species would be speedily sacrificed to predaceous and cannibalistic tendencies, were there no compensating conditions coexistent with that apparently defenseless period of their existence. But nature, in her economy, appears to strive to guard against extinction. Thus, it is said that certain defenseless species have the power of vision developed to that degree that they are enabled, with due vigilance, to keep a safe distance between themselves and their rapacious but short-sighted enemies; that others are so identified in color and appearance with the waters they inhabit as to be scarcely discernible; and that others still are so surrounded with incidental protective agencies that they enjoy some degree of immunity from the ravages of predaceous species. Of course the circumstances which afford protection in one case may be entirely inoperative to protect fish at another stage of development or belonging to another species. Minnow life may emerge unharmed from surroundings that would insure total destruction to the same individuals at later stages of maturity. Thus, the frailty and insignificance of whitefish minnows are, of themselves, ample safeguards against destruction by the larger deep-water fishes with which they instinctively seek to associate from the moment they are released from their shell inclosures For several weeks they are so minute, to say nothing of their being nearly transparent and invisible, as to render it quite unlikely that they are preyed upon by anything within the range of deep-water fishes. Doubtless there is some loss by starvation, and some are strained out by gill-rakers, along with fish-food collected in this way. Such losses, however, are merely incidental.

These same minnows would doubtless be destroyed by the "chubs" and "shiners" that swarm inshore by the thousands, evidently to keep out of the way of the larger rapacious fishes. But from actual observation I am able to say that the whitefish minnows invariably go to deep water when planted in shoal places. In such cases they settle towards the bottom, heading to deep water, and soon pass out of sight. I have noticed also that when deposited in deep water they do not remain at the surface, but almost immediately work down out of sight.

We grant that the sauger is not a large fish; but obviously it is too large to pay any attention to the minute whitefish minnow. It is very doubtful if even the fry of brook trout would be molested by the saugers, and yet the relative size of trout and whitefish fry is such that the latter speedily disappear in the presence of the former. A dozen trout

two months old will clean out a tank containing a thousand whitefish of the same age in an incredibly short time, simply by picking them off like particles or small shreds of liver on which they are usually fed. But these same whitefish are perfectly safe in the presence of trout 3 or 4 years old—they are too small to be noticed. Experiments demonstrating these facts have been tried repeatedly at the Northville Hatchery.

Every trout breeder well understands that food for pond fish should not be too minutely subdivided, as pieces much larger than whitefish minnows go unnoticed by the fish, and, subsiding to the bottom, foul the ponds. It is well understood, even by the barefooted boy, that the morsel of bait with which he would entice our small native fishes from their haunts must not be too insignificant.

We do not know what success one might have in angling for saugers with whitefish minnows as bait, but I venture to say that a thousand hooks bated with these minnows, and each manipulated by an expert angler, would fail to secure a score of fish a day, even though a dozen minnows were used at a single baiting. Angling for saugers, either for pleasure or profit, with particles of bait no larger than the whitefish are for six weeks after leaving our hatcheries, would be attended with such meager results that it would speedily cease.

We are aware that it is freely maintained that, to secure the best possible results, all minnows should be released near the natural spawning beds of their species, so that they might have at least an equal chance with the indigenous minnows. This theory sounds plausible enough, but it remains to be shown that such localities possess any special advantages for minnow life. The conditions necessary to the existence of embryos and minnows are entirely different. Now, it would be absurd to claim that the honey-combed rocks and reefs always selected by the coregoni for spawning beds are in any way connected with the necessities of the minnows; and yet it is absolutely necessary, if the species is to be perpetuated in a state of nature, that the eggs should be deposited on beds of this character; since, in view of the long period of incubation, and the rapid development and insidious nature of conferva, they must all perish but for the complete isolation the numerous cells of these rocks and reefs afford. As the minnows are no better provided for at such points than elsewhere, it is evident that nature directs the parent fish to select spawning beds wholly with reference to the demands of the embryos. The absence of appropriate beds is doubtless the missing link in the chain of conditions necessary to perpetuate the species in many of our small inland waters where all the other links are present.

NORTHVILLE, MICH., *April*, 1883.

Vol. III, No. 23. Washington, D. C. Oct. 19, 1883.

59.—THE EDIBLE CLAMS OF THE PACIFIC COAST AND A PROPOSED METHOD OF TRANSPLANTING THEM TO THE ATLANTIC COAST.

By R. E. C. STEARNS.

[Letter to Prof. S. F. Baird.]

In pursuance of the general instructions expressed in your letter of March 3, 1882, relating to the economic value of certain edible mollusks of the Pacific coast, and directions to inquire into the special peculiarities of their habitat, for the purpose of determining the feasibility of transplanting the same from the waters of the Pacific to those of the Atlantic side of the continent, both as a scientific experiment and as a resource in case of future contingencies, I took the requisite steps in the latter part of the following May to carry out your wishes, by having the necessary equipment made as referred to in my letter to you dated May 8, 1882.*

In addition to the facts previously of record, with further data obtained from various intelligent persons, supported by my own judgment, I concluded that some point on Puget Sound or within the Puget Sound infratidal region offered many advantages over any locality to the southward of the above and along the exterior or ocean coast, though all of the species which we had in mind occur at various places along the shore, even as far to the south as San Diego, a reach of over 1,100 miles.

Of the many favorable points on the Sound, I fixed upon Budd's Inlet, as the preferable locality, as the three species required were reported as being found there in considerable abundance and within a limited area, and convenient to a good base, namely, the town of Olympia.

The species sought for were *Glycimeris generosa*,† or geoduck as locally called, *Saxidomus nuttallii*,‡ the quahaug of some of the people in the region, and *Schizothærus nuttallii*,§ which had been particularly recommended.

Besides the above I hoped to find other forms of economic and scientific value.

I finally got my equipment together so as to leave San Francisco on

NOTE.—Previous communications on this subject may be found in the Bulletin of the United States Fish Commission, Volume I, pp. 21, 200: II, pp. 20.—C. W. S.

* Bull. United States Fish Commission, 1882, pp. 20-21.

† By Mr. Hemphill.

‡ By Dr. Dall.

§ In my letter of May 8, and *ante*.

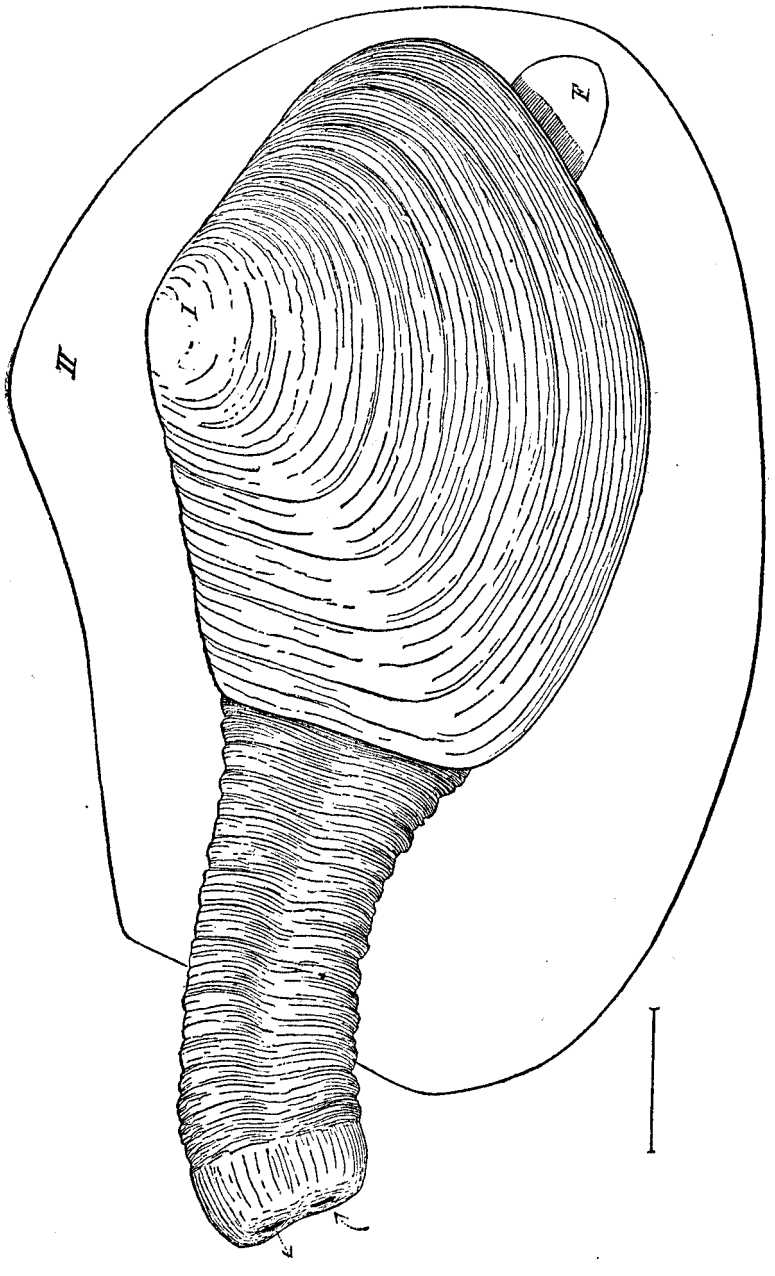

FIG. 1.—*Schizothærus nuttallii* Conrad. *Tresus maximus* Midd.; Gray. *Lutraria capax* Gould. West Coast, United States; Puget Sound to San Diego, California.

I. Specimen of ordinary size, reduced about one-fourth in length. The siphons are somewhat contracted; the foot (F) expands about as usual.

II. Outline of the left valve of a larger specimen, reduced to the same extent.

The straight line below the siphons represents a length of one inch on the figures.

Drawn from nature by R. E. C. Stearns.

the third of June, and after arriving in Portland, Oregon, where I remained several days, seeking for such information as might be of value hereafter, I arrived at Olympia on the afternoon of the 12th and the next morning proceeded to business. Unfortunately the persons to whom I had letters were out of town, but Captain Doane, an old Californian whom I came across, kindly placed at my service, rent free, a part of his building on one of the wharves, which, after a few slight repairs, made a convenient laboratory, where I arranged my tanks and other implements.

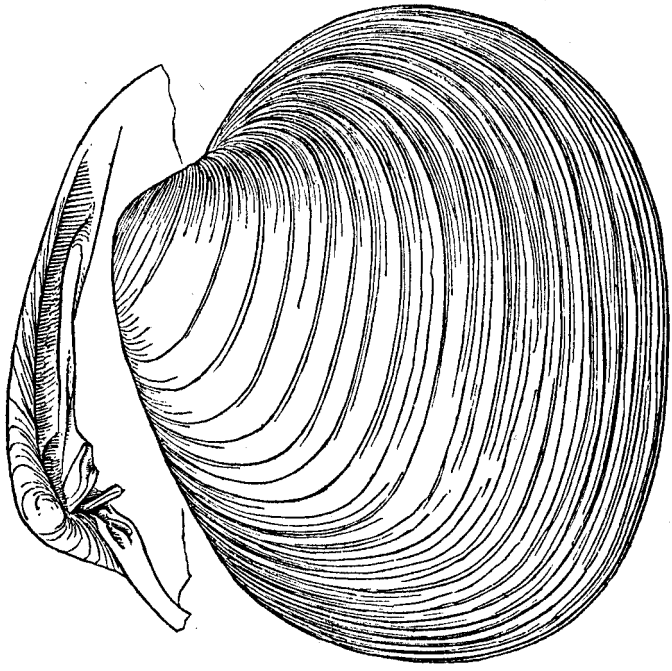

FIG 2.—*Saxidomusi nuttalli* Conrad. *Saxidomus aratus* Gould. *Saxidomus squalidus* Desh. *Saxidomus brevisiphonatus* Cpr.

West Coast, North America; Alaska to San Diego, Cal.
Natural size of a large specimen.
Drawn by J. H. Emerton.

I found it quite difficult to obtain intelligent assistance, and also felt somewhat embarrassed from not knowing how large an expenditure I might be justified in making. So I confined myself to the use of one man and a boat, and otherwise employed some of the Indians to bring in such clams as they could find. I discovered, however, that the red man of this region, as elsewhere on the coast, is particularly apathetic regarding anything like labor, and that many of the pale faces hereabout are not anxious to work.

As anticipated, I find *Glycimeris*, *Saxidomus*, and *Schizothærus* all here, also the common *Tapes* (properly *Cuneus*) *staminea*, *Cardium corbis*, and

Mytilus edulis; the latter wonderfully abundant, adhering to the piles all around the town, and in broad patches covering the flats exposed at low tide. They are not eaten to any extent, the clams of the neighborhood being abundant and preferable. *Zirphœa crispata* is also found and attains the extraordinary size of 12 to 13 inches from anterior extremity to end of siphons, the shell being 5 inches of the above length, while the girth is 9 inches just posterior to the umbos. The only gasteropods noticed were *Littorina scutulata* Gld., *Lunatia lewisii* Gould, and *Purpura crispata* Chem.; of the latter numerous finely foliated specimens were obtained, and a curiously dwarfed variety of *Acmæa pelta* on the local oyster, which latter is small, dark colored, and inferior. I found that the peculiar occurrence of the lowest tides would not permit me to give my attention to other species than those which I had especially in view at the time I started.

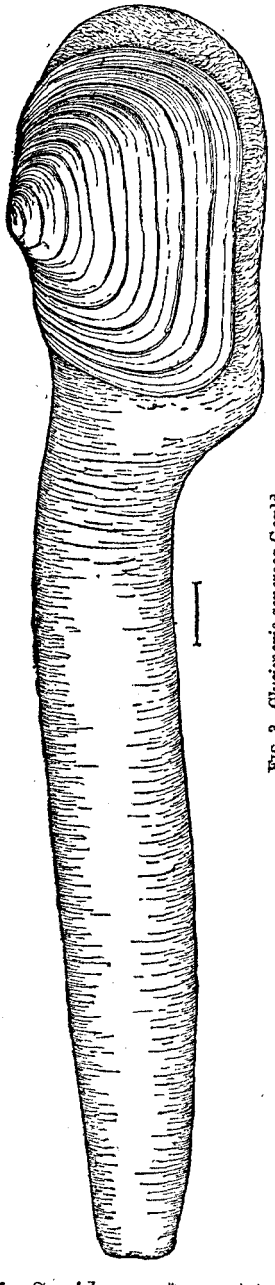

FIG. 3. *Glycimeris generosa* Gould. West Coast, United States; Puget Sound to San Diego, Cal. Specimen with siphons extended; weight when alive 5¼ pounds. The line underneath the figure represents a length of one inch. Drawn by R. E. C. Stearns.

As Budd's Inlet is to Puget Sound, namely, an arm thereof, so are several smaller bays or minor estuaries to Budd's Inlet. These latter are variously known as South Bay, Mud Bay, &c., and the character of their beds varies but little, one compared with the other, the variation being expressed by the terms "muddy sand" or "sandy mud." At the head of the inlet and in the front of the town, for considerable distance toward the mouth, the alluvium brought down by the stream known as Tumwater, combined with more or less drainage and refuse matter from the town, causes a deposit of ordinary slimy mud along and on both sides of the channel; but this, as elsewhere, overlies a yellowish sand, the same as may be seen in the hills and whereever a cut has been made in the neighborhood; this sand in some places contains more or less gravel, pebbles, and small bowlders.

The principal clam used here by the whites is *Saxidomus;** next to this *Cuneus* or *Tapes*, sometimes called the "little round clam," and occasionally only the mammoth *Glycimeris* or geoduck.

**Saxidomus* is fully equal, if not superior, as many persons think, to the Atlantic quahaug. It occurs plentifully not alone around Puget Sound, but at many points on

The cockle, *Cardium corbis*, is also used to a limited extent by the whites; all of the above are eaten by the Indians, while *Schizothærus*, which is certainly superior for its flavor and delicacy, closely approaching the best oysters in these respects, is not eaten by the whites in the immediate neighborhood, though preferred by the Indians above all the others. I except the geoduck, for this species is not sufficiently abundant to cut much of a figure as a constant source of supply. It is, however, a real delicacy, and, skillfully cooked, would completely puzzle persons who tasted it for the first time as to whether they were eating fish, flesh, or fowl. The nearest guess that I have heard was by a person to whom I gave a piece, "that it tasted a little, perhaps, like nicely stewed crab," which hits the mark as nearly as possible. The proper way to cook geoduck, or one way, is to parboil thoroughly, then remove the skin and cut in strips about one inch and a half wide by a third of an inch thick, and fry the same in batter, in very, *very*, hot salt-pork fat. I dare to say that parboiled, then stuffed and baked, or

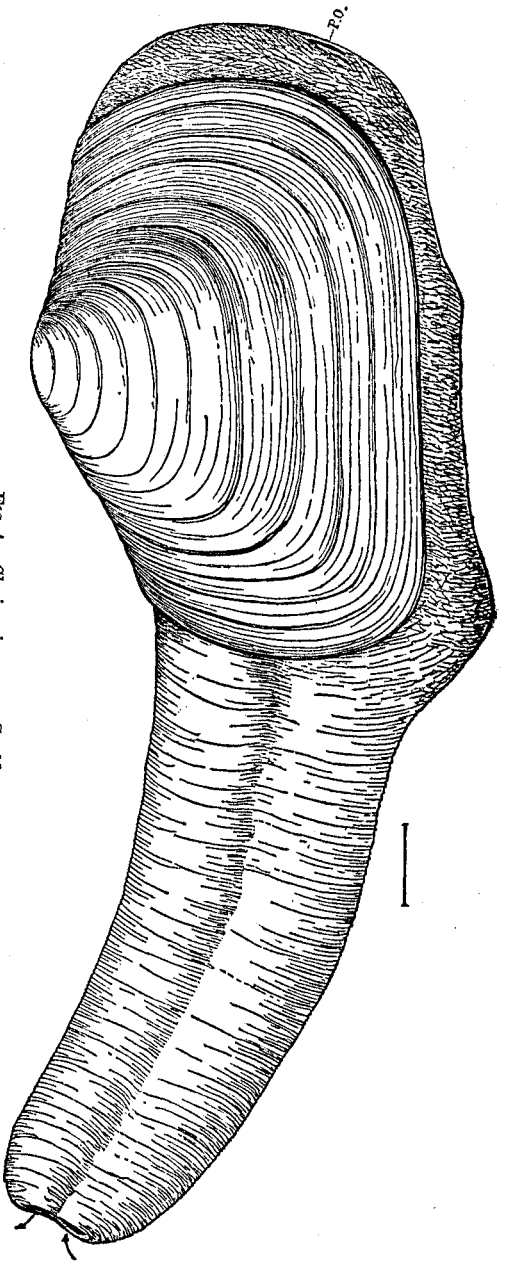

FIG. 4.—*Glycimeris generosa* Gould.

Specimen with siphons partly contracted; weight when alive 6¾ pounds. P. O., pedal orifice. Drawn by R. E. C. Stearns.

the coast of California, especially at Bodega and thereabouts and San Diego. It is more nearly like the Atlantic quahaug than it is to *Mya arenaria*, which is becoming plentiful on the Pacific Coast, and is now the principal clam in San Francisco market. As heretofore stated by me in the American Naturalist, *Mya* is an introduced species, having been planted in San Francisco Bay with Atlantic oysters. Should California packers be able to compete with their eastern competitors the *Saxidomi* will furnish a good source of supply.

roasted, geoduck would prove highly satisfactory to the daintiest epicure. Mr. Hemphill thought the taste like that of poached eggs. If fresh and well cooked, it is suitable food for very good men of scientific proclivities.

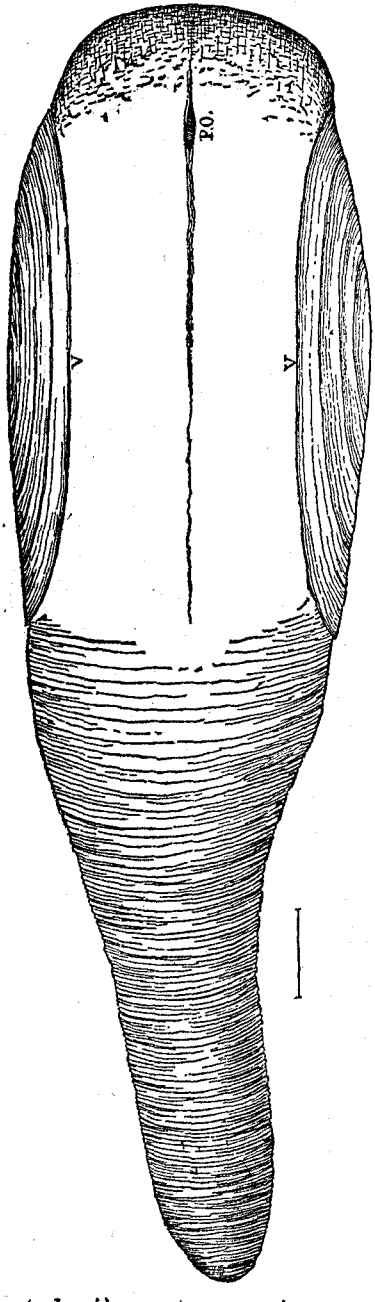

FIG. 5.—*Glycimeris generosa* Gould. Drawn by R. E. C. Stearns.

Ventral view of preceding specimen, showing pedal orifice (P. O.) and lower edges of valves (V V).

While the other clams are obtainable during the recession of the ordinary tides, during the year, *Glycimeris* can only be secured during the extreme tides which occur in this region from the middle of May to the latter part of June, when the difference between high and low water is about 20 feet; that is to say, with rare exceptions. It burrows in muddy sand, or apparently prefers such a place, and the depth of its burrow is from two and a half to three feet. To take one out uninjured requires careful digging and the removal of at least a barrel of mud. Mr. Hemphill remarks: "It is very rare at San Diego. I have not found a dozen specimens during the several years I have collected here, while at Olympia three men could secure a dozen at one low tide or in one day." To this I would add, provided that the exact site of each individual had previously been ascertained and marked with a stake. As many as three men would be required to work economically.

By the 23d of June, the "long-run outs," as these extreme low-tides are called, had ceased, and the weather for several days had been quite warm. The Indians whom I had sent out a day or two before, and one white man also, returned in the morning with some of the common species, but none of the geoducks. I had previously collected nine or ten specimens, and hoped to get more, as some of the others had died. While in Olympia, only one lot had been brought into town during a fortnight—about a dozen; of these I bought six, the

others were in a damaged condition. Some of those purchased had been handled too roughly for transportation alive. I found by experiment that the geoduck, carefully dug and handled, would, with proper change of water and cool weather, keep alive ten days packed in rock-weed, first being protected by winding and tying a band of brown sheeting cloth, an inch and a half in width, to support the animal and take the place of the natural support which the mud furnishes when the mollusk is in its native bed. The coincident occurrence of the extreme low tides necessary to collect living specimens, and of warm weather, as usual here and along the coast at the time when these low tides occur, is unfortunate, as heat is the principal source of danger. The intention of packing in mud in the tanks had to be abandoned, as I found the means for handling the loaded tanks were wanting, the boats being too small, and a certain amount of tackle being required for the purpose; so rock-weed was used instead. I found, also, that *Schizothærus* was the least tenacious of life, and survived removal from the clam-beds but about three days, at farthest, even when carefully attended to, water changed, &c.

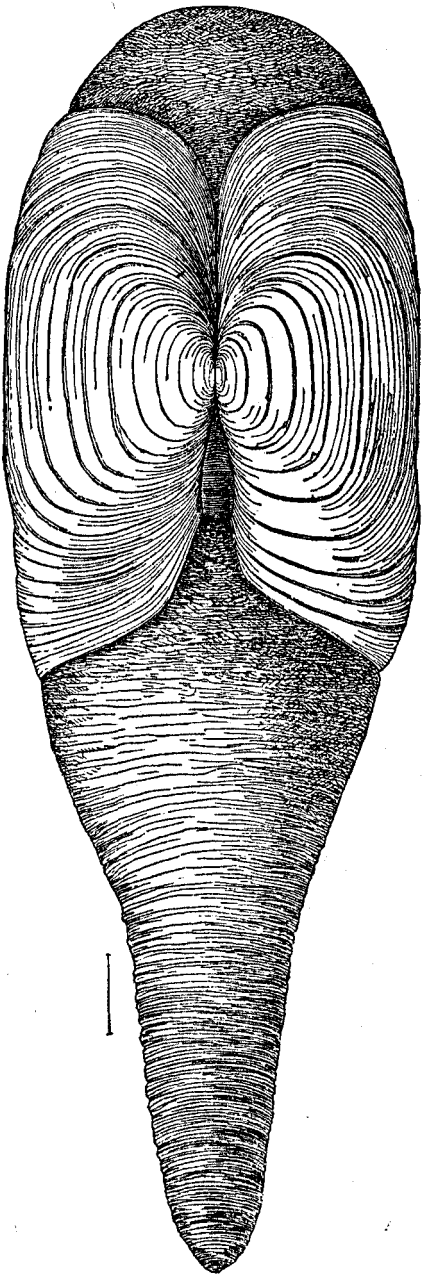

FIG. 6.—*Glycimeris generosa* Gould.

Dorsal view of a specimen weighing about 7 pounds; siphons contracted. Drawn by R. E. C. Stearns.

This clam occurs in quantities sufficient, quality considered, to warrant packing in cans. The clams now canned, while perhaps meeting a limited sale on the Pacific coast, cannot compete with the clams (*Mya arenaria*) and quahaugs (*Mercenaria violacea*) of the Atlantic packers in the markets of the world, though *Saxidomus*, which is not yet canned, is really of most excellent quality. *Schizothærus*, after removing the neck or siphons,

considering the comparatively small size of the adductors, is as tender as an oyster. Being nearly all belly, it is of sufficient size, when shelled, for two to eight to fill a two-pound can.

I am of the opinion that this species, carefully packed and properly put upon the market, would soon be regarded as next to the best packings of the Virginia oyster, and would find a ready sale.

On the 24th of June I left Olympia, with tanks, etc., via Portland, Oreg., for San Francisco, and arrived at the latter place June 27, at 8.30 a m. Weather warm.

Through the kindness of the officers of the steamer, extra care and attention was given to the tanks and contents; but upon examination, after getting the same ashore, *Glycimeris*, *Schizothærus*, and *Saxidomus*, all were dead, though still quite fresh and sweet.

Aside from other information and experience derived from this experiment, the route via Portland, owing to the frequent handling required, is impracticable. If future attempts are made before the completion of the North Pacific Transcontinental Railroad admits of a special car being run through to Puget Sound, then the best route will be by some one of the Puget Sound steamers to San Francisco direct. The clams can be obtained at some other point on the sound, or else dug in Budd's Inlet and replanted in the immediate vicinity of some regular shipping station; or some other locality, perhaps, where *Glycimeris* occurs, may be found nearer to the points where the sound steamers touch in the course of their usual trips. I am however, inclined to doubt the practicability of handling these clams successfully, via San Francisco, for the reason heretofore given, namely, the coincidence of these low tides with the warm weather which pertains to that time of the year.

I should have mentioned before that, though *Glycimeris* sometimes attains the weight of 16 pounds, as I am informed by Capt. J. S. Lawson, of the United States Coast Survey, to whom I am indebted for kind assistance, the largest obtained by me weighed 6½ to 7½ pounds. There is no doubt, however, that individuals reach and even exceed the weight mentioned.

Herewith are drawings of two specimens of different weights, and in different positions, such as are usually presented by the geoduck, which is probably the largest *Saxicavid* known, and next to the true clam of the Indo-Pacific seas, *Tridacna gigas*, the largest clam in the world.

I have also provided drawings of *Schizothærus nuttallii*, and of the tanks which I had prepared for the special object of my mission, and which I believe are well adapted for the purpose.

DESCRIPTION OF THE STEARNS TANK FOR THE TRANSPORTATION OF CLAMS, ETC., FOR TRANSPLANTING.

The tanks, which were made in San Francisco under my direction for the above purpose, are of heavy galvanized sheet iron; the upper edge and bottom further strengthened by a stout hoop or band, marked

B in Fig. 7; the lower hoop projects below the bottom sufficiently to receive the wear.

At the bottom, and at a point about one-third the height of the tank from the top, are outlets O O, nozzled out an inch or so for drainage; these nozzles are reinforced with a shoulder of solder all around the outside, next to the body of the tank. When the clams are to be packed in mud or sand the lower outlet is stopped with a bung or a cork, the mud filled in to a line even with the upper outlet; said outlet is stopped and the space between the level of the mud and the top of the tank filled with water, and the screen, Fig. 8, placed upon the

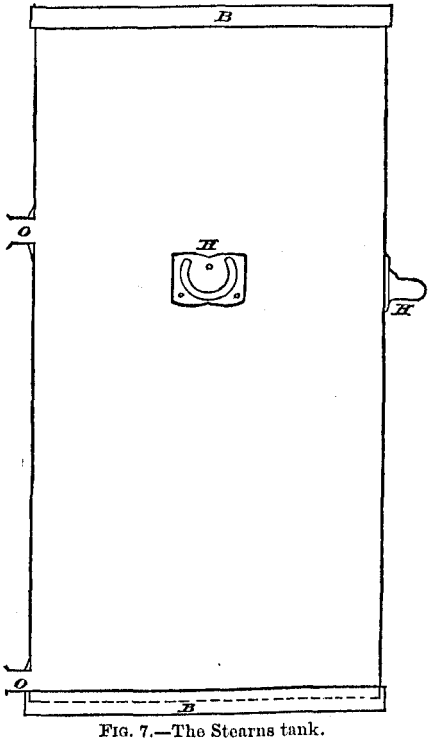

FIG. 7.—The Stearns tank.

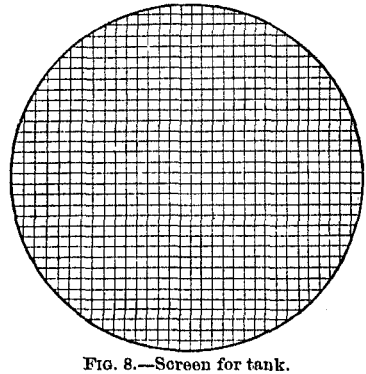

FIG. 8.—Screen for tank.

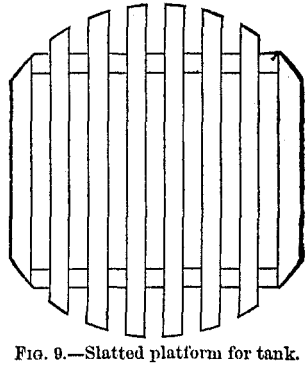

FIG. 9.—Slatted platform for tank.

top, resting upon angle-irons, L, just below the edge, to prevent the contents of tanks being molested by inquisitive persons during transportation. All that is required when change of water is necessary is to withdraw the bung or cork, run off the stale water, and again stop the outlet and refill with the water from a pail, etc.

When clams are to be carried in rock-weed, &c., then a slatted platform, of strips of wood, nailed to cross-cleats of sufficient height or thickness as to permit a space of three or four inches above the bottom, to receive the water and to keep the rock-weed packing above the bottom of the tank, so as to facilitate drainage when the water is changed, which is readily done by pulling out the cork or plug which stops the

lower orifice or nozzle. This permits giving the clams an occasional douche or bath of salt water while in transit, and the ready removal of stagnant or stale water. The tank is 3 feet in height by 1 foot 6 inches in diameter. It is provided with three stout handles which turn up, and when so turned, stop at a right angle with the side of the tank, so as not to pinch the hands when the tank is lifted. One of these handles is placed opposite the upper nozzle, the other two at points equidistant, on each side, between the first handle and the upper nozzle.

These tanks, substantially made of galvanized iron, handles of the same, also screen cover of galvanized wire, cost complete in San Francisco $7.80.

BERKELEY, CAL., *October* 14, 1882.

60.—RETURN TO GLOUCESTER OF YOUNG CODFISH HATCHED BY UNITED STATES FISH COMMISSION IN 1879.

By BENJAMIN H. SPINNEY.

[From a letter to Prof. S. F. Baird.]

I have made inquiry about the codfish taken in Gloucester Harbor, and find several of the boat fishermen who are of the opinion that they are the ones that you hatched here in 1878. They are of a gray color and resemble somewhat a deep-water fish. They came in schools about May 1, and staid till the middle or last of July. Sometimes they are very plenty. I saw one man who said that he caught 70 or 80 pounds on a mackerel line while at anchor just off Five Pound Island, and that they would weigh from a half pound to two and a half pounds each. I have seen schools of them myself alongside of my wharf at the head of the harbor. I will try to get a sample and send you.

EAST GLOUCESTER, MASS., *August* 18, 1883.

NOTE.—Compare report of the return of these cod in 1882: Bull. United States Fish Commission, 1882, Vol. II, p. 112.—C. W. S.

61.—THE CULTIVATION OF CROPPIES IN PONDS.

By S. P. BARTLETT.

[From a letter to Prof. S. F. Baird.]

In 1880, Colonel Don. Morrison built upon his farm a reservoir and placed in it a few croppy of that year's spawning, which were sent to him by the Illinois Fish Commission. August 30, 1883, he undertook to seine it and take out the catfish. In this he partially failed, and among the fish taken were a number of croppies which weighed nearly two pounds each. One of these he kept and showed me the next day. So in a number of instances as great growth has been shown.

QUINCY, ILL., *September* 18, 1883.

62.—MEMORIAL ADDRESSED TO THE BUREAU OF AGRICULTURE OF THE IMPERIAL SENATE FOR FINLAND, JANUARY 20, 1883, IN REGARD TO THE ADVISABILITY OF INTRODUCING ARTIFICIAL FISH-CULTURE IN FINLAND.*

By PROF. A. J. MALMGREN.

After having visited, in September last, the piscicultural establishment of Nikolsk, in the Government of Nowgorod, in compliance with a written request of the bureau of agriculture of the imperial senate, dated June 15, 1882, I now take the liberty, in obedience to one of the instructions therein contained, to report on my journey and the observations made during the same, giving at the same time my opinion as to the advisability of introducing artificial fish-culture in Finland, and more especially as to the practicability of employing the system adopted at Nikolsk.

After having been furnished with a letter of introduction from Baron E. af Forselles, then vice-governor-general, to the various authorities of the empire with whom I would come in contact, I started for St. Petersburg on the 10th of September, accompanied by the inspector of the depot at Hyvinge, captain in the guards Fr. Häyrén, who was to act as my interpreter. Soon after my arrival at St. Petersburg I was furnished with another letter of recommendation, principally through the kindness of Mr. E. Streng, first secretary in the imperial ministry of Domains, to the director of the piscicultural establishment at Nikolsk. On the following day I left St. Petersburg by the Nikolajew Railway, traveling about 250 wersts [167 miles], as far as the station of Waldaika, and on the next day 78 wersts [52 miles], by stage-coach to Nikolsk, which is about 40 wersts [27 miles] distant from Waldai, the capital of that district. Here we staid 24 hours with the amiable director of the establishment, Dr. O. Grimm, professor at the Academy of Forestry in St. Petersburg, who had spent his summer vacation here with his family, and lived in a house belonging to the establishment and located between the fish-ponds.

The founder of this establishment is Wladimir Pawlowitsch Wrasky, a man of noble ancestry, whose mother is said to have been a Tolstoi. Whilst pursuing his studies at the University of Dorpat, where he obtained the degree of "Candidate," he read the works of Coste and other authors on artificial fish-culture, which awakened such a lively interest in him for this new industry, which was then but little known and had hardly been put to a practical test, as to determine him to devote him-

*"*An die Ackerbau-Expedition im kaiserlichen Senat für Finnland von dem Inspector der Fischereien den 20 Januar abgegebene Gutachten, in wiefern es geeignet wäre in Finnland künstliche Fischzucht einzuführen.*" Helsingfors, 1883. Translated from the German by HERMAN JACOBSON.

NOTE.—Professor Malmgren is the inspector of fisheries in Finland.—C. W. S.

self entirely to fish-culture. After having made himself acquainted—both by experiments of his own and by journeys in foreign countries—with the methods then applied to artificial fish-culture, he commenced during the years 1855–1856 to establish on his family estate a piscicultural institution after the model of the one at Hüningen, in Alsace. The location selected by him was the lower portion of a valley between Lake Pestow and Lake Welje, into which a small stream flows. Here he made 13 large and small ponds, or basins, according to the directions of Sudakewitsch, which involved a very considerable expense. At the time of our visit, however, only six large ponds seemed to be occupied. These ponds are connected with each other, and with the stream referred to, by means of sluices and subterranean channels, so that they can be filled or emptied as occasion requires. The hatching-house, built solidly and furnished in the most lavish manner, is of such vast dimensions that several millions of fish-eggs can be hatched at one and the same time. This hatching-house shows, even more than the large ponds (all of which had to be dug out), how firmly the founder of the establishment was convinced of the profitableness of the undertaking. This conviction prompted him to shun no expense to make his establishment a model one, arranged according to a plan of his own, and furnished with all the mechanical appliances then known.

After Wrasky had sunk all his property in this undertaking, he formed an association, which expended its entire capital of 41,000 roubles [about $28,700] in maintaining and developing the establishment. Although this association received a subsidy of 30,000 roubles [about $21,000] from the Government, it soon became financially embarrassed, and owing to this circumstance the Government took possession of the establishment. This took place in 1868. Wrasky had meanwhile become poor, and the association bankrupt. It has never been known with absolute certainty what it cost to start the piscicultural establishment of Nikolsk; Sudakewitsch says in his report that it was upwards of 100,000 roubles [about $70,000], whilst Professor Grimm estimates it at 200,000 roubles [about $140,000]. I could not learn what are the present expenses of keeping up the establishment, but Professor Grimm told me that there was an annual appropriation for it, amounting to 3,000 roubles [about $2,100], of which 2,400 roubles [about $1,680] was his fixed salary.

The hatching-house, the most important part of the establishment, consists of one very large room with four heating apparatuses, and several small rooms which are used by the director as a laboratory and for various other purposes. It is located immediately below the largest pond, and is furnished with many pipes, which uninterruptedly supply all the water needed in this establishment. Along the middle of the large rooms there extends a deep and spacious basin laid in brick, which, if necessary, can be divided into several small basins, so that the fish can be kept separate during the process of hatching. The im

pregnated eggs are hatched on eight large hatching-frames resting on a walled foundation of so-called Putiloff stones, arranged on both sides in double rows. According to Professor Grimm's opinion they are sufficient to receive at one and the same time 5 million eggs of the *Coregonus*,* or 2 million trout-eggs. Besides these expensive hatching-frames another peculiarity deserves attention, viz, the fact that the impregnated eggs, for the purpose of developing, are placed on square porcelain plates, having a surface of about 4 square inches, with a low edge, bent upwards; and that these plates are placed close to each other on the bottom of the hatching-frames, where an uninterrupted stream of water is caused to flow over them. Although this method (to cause water to flow over the eggs) is said to have produced excellent results, it must be considered as antiquated, after cheaper methods, saving both space and water, have been invented in America and have been introduced very extensively not only in that country but also in Europe. The hatching-house of Nikolsk is under the care of a superintendent and assistants, who live in the establishment.

The Nikolsk ponds are used partly for keeping and raising the breeding fish, trout and *Coregonus*, partly for raising sterlet, and several other less valuable kinds of fish. A special superintendent had charge of these ponds and attended to the feeding of the fish kept in them. He likewise was furnished with a house by the establishment.

As the kinds of fish which are raised in Nikolsk (the *Coregonus* and the trout) are not found there, it became necessary to get the first fish from St. Petersburg, a distance of about 350 wersts [233 miles]. The trout which are now in the ponds belonging to the Nikolsk establishment came from streams near Gatschina (Sudakewitsch) and the *Coregonus* from fish-tanks in St. Petersburg. It is true that trout have been found at Jaschelbitsch, distant about 35 wersts [23 miles], but only quite recently they have been used, to a limited extent, for the purpose of obtaining spawn. This circumstance, *i. e.*, the lack of spawning fish in the immediate neighborhood and the isolated location of the establishment, as well as the insufficient means of communication, have of course restricted its work in more ways than one. The largest number of eggs which have been in the establishment at the same time is 300,000; but generally it is much smaller, hardly 100,000. The entire number of trout and *Coregonus* eggs which have been raised here in the course of ten years seems not to have been more than what is raised in some of the larger piscicultural establishments in Germany in one year. The annual production of young fry in some of the salmon-hatching establishments which formerly existed in Finland was at least as great if not greater than that of the Nikolsk establishment; at least, judging from the statistics furnished by Professor Grimm. Thus there were in 1861 deposited in the hatch-

* *Coregonus maræna* Bloch. *Marän* in the original, here and throughout the paper. For facts regarding the habitat and culture of this species see Report of Prof. S. F. Baird, Commissioner, for 1876–'77, pp. *39, *40.—C. W. S.

ing-boxes of the salmon-hatching establishment near Kexholm, in Finland, about 300,000 eggs, from which there were raised more than 200,000 young fish, which were placed in the Wuoksen River; and in the Kymmene establishment [also in Finland] there were often raised about 100,000 young salmon per annum. Professor Grimm has, therefore, seen fit to establish a branch of the Nikolsk establishment in the building of the Imperial Museum of Agriculture in St. Petersburg, where the hatching of *Coregonus* and salmon eggs is carried on upon a larger or at least just as large a scale as in Nikolsk, but with more modern apparatus and at far less expense.

As regards the other work of the Nikolsk establishment, and the rerults obtained by it, I take the liberty to refer my readers to two reports published in a Russian journal* by Professor Grimm, the one embracing the period 1869–1880, and the other the year 1881. One need not be a specialist to learn from these reports that the Nikolsk establishment, as a financial enterprise, or judged according to its usefulness to the Government, is and always will remain a failure. Although, judged from a technical point of view, the establishment is a model one, and the judicious management of Professor Grimm leaves nothing to be desired, its financial or economical results are either none at all or utterly insignificant when compared with the size of the establishment and the amount of money required even now for its support. The few hundred trout and *Coregonus* which are at present carefully tended in the Nikolsk ponds, and which, according to Professor Grimm's report, are the only visible result of the 25 years of the existence of this establishment, would, if brought into the market, even in St. Petersburg, not realize the sum required to support the establishment for a single year. Fishing in Lake Pestow, which belongs to the establishment, has not increased, in spite of the most zealous attempts to raise fish in that lake. In 1872 more fish were caught in that lake than during any of the succeeding years, even more than 1881, which was considered a good fish year. Very few *Coregonus* and still fewer trout are found in the lake, although since Wrasky's time every year a large number of young fish of both kinds have been placed in it. It appears from Professor Grimm's report that in 1870 there were caught in Lake Pestow, in all, 71 *Coregonus* and 6 trout, and 1873 only 4 *Coregonus* and no trout. The transplanting of fish, which is done here in the same manner as in Finland, by transferring mature spawning fish from Lake Welje to Lake Pestow, has been productive of better results. Thus the little märäne (*Coregonus albula*), which was transferred to Lake Pestow in 1872, has become entirely acclimatized, although even now it does not occur in any very considerable number; and the smelt, of which a large number of matured specimens were placed in Lake Pestow in 1872, have increased to such an extent that annually 150 to 200 pud [5,400 to 7,200 pounds] of these fish are caught. The number of trout, however, seems

* *Sel. Khoz. Ilys.* St. Petersburg, 1881 and 1882, Vols. XXXVI–XXXIX.

to have decreased, as the smelt have increased. The yield of fish of the Pestow Lake is the same as it was in former times, which proves that no sheet of water can produce more fish than is determined by its quantity of suitable fish-food.

As a correction of and addition to Professor Grimm's report respecting the persevering attempts, to transfer the *Coregonus* to the river Wolga, by transferring young *Coregonus* from Nikolsk to Lake Seliger, which is connected with the Wolga, I take the liberty to state, as I have been informed by Professor Grimm, that no *Coregonus* whatever are found in Lake Seliger, and that, so far at least, they have not been acclimatized in the Wolga. It seems to be certain that the Wolga *Coregonus* mentioned by Wassiltschikoff as found in the neighborhood of Nischnij Nowgorod, are no *Coregonus* but grayling. As regards the results of the transfer from Nikolsk of young fish and impregnated eggs of *Coregonus* and trout, which has been made every year since 1870, Professor Grimm could not give me any further information than that a trout-hatching establishment near Moscow, which got its fish from Nikolsk, had been reasonably successful, and that the experiment of stocking a small pond near St. Petersburg with young trout, made by an employé of the Museum of Agriculture and a farmer of the neighborhood, yielded a few hundred roubles the first year after the fish had been placed in said pond, but that during the following year the experiment proved an entire failure. It is probable that the trout-food in this pond had been used up during the first year, and that, as usual, it was difficult to renew it.

Professor Grimm informed me that he had made an interesting experiment with sterlet, which I feel it my duty to communicate here. During the years 1869–1871, 120 young sterlet had been brought to Nikolsk and placed partly in Lake Pestow and partly in the ponds belonging to the establishment. These fish grew and flourished till they had reached their natural size, but they never spawned, and none of them had either roe or milt during all the time they were at Nikolsk. The observation is said to have been made in Russia, especially in some convents, that this fish is not capable of propagation in lakes or ponds or in stagnant water. The sterlet is a genuine river-fish, which only propagates its species in rapidly flowing water. It spawns in spring, after the water in the rivers and streams begins to fall, and its eggs, which adhere to stones and other objects, are said to develop in an incredible short time, viz, four days. It seems, therefore, that it is exceedingly difficult to transplant this fish by means of the transferring of impregnated eggs. It is said, on the other hand, that young sterlets can easily be transported a considerable distance; they can be bought at a reasonable price at Samara from Messrs. Mjäsniskoff and Tischinskij (see the "*Golos*," No. 311, November 15, 1882). In view of the high price of these fish Professor Grimm intends to devote himself, in future more than heretofore, to the raising of sterlets in the Nikolsk ponds, because,

owing to the great expense of transportation from Nikolsk to St. Petersburg and Moscow, the raising of other kinds of fish does not offer any great inducement. As early as during the reigns of Frederick I and Frederick the Great, sterlets were introduced in Prussia and placed in several lakes, where, however, they did not propagate. The same will doubtless be the case with those sterlets which the Duke of Sutherland some time ago transferred to a lake in Scotland.

As regards the mission of the Nikolsk establishment to serve as a school of fish culture, it has not been carried out in any degree worth speaking of, because, on account of its out-of-the-way location, the establishment is but rarely visited, and has, in fact, until quite recently hardly been known.

As regards fish-culture in Russia in general I gathered the following data: According to Sudakewitsch, Dr. J. Knoch had, as far back as 1857, commenced to raise carp in some ponds on the estate of Strelna, belonging to the Grand Duke Konstantin Nikolajewitsch; and somewhat later the same doctor is said to have founded a piscicultural establishment on an estate belonging to the Grand Duke Nikolai Nikolajewitsch, but with what result I could not learn. Several scientists have also occupied themselves with the artificial hatching of fish-eggs, but they did this exclusively for scientific purposes and for studying the early development of the different kinds of sturgeons, especially the sterlets. During the last few years Mr. K. Muschinsky, a banker, has hatched *Coregonus* and trout eggs in his house in St. Petersburg, No. 54 Newski Prospect, and has had the young fry transported to his estate in Poland. Among those persons in Russia who have begun to take a lively interest in fish-culture, since the Berlin Exposition of 1880, Chamberlain and Counsellor of State W. von Greig occupies the most prominent place. At Weessen, one of his estates in Courland, he has founded an extensive and model piscicultural establishment, with large ponds, aqueducts, and cascades. According to the report of the German Professor Benecke, sterlets and carp had been raised there as early as 1881; the young fry of the latter fish had been brought from Germany; they also raise there brook and lake trout and *Coregonus*. When Professor Benecke visited the establishment it was not yet finished, but there was every prospect of its completion within a short time. After the model of the aristocratic German Fishery Association in Berlin, of which the German Crown Prince is the patron, and Chamberlain von Behr, of Schmoldow, has been director for the last 7 or 8 years, there was founded last year at St. Petersburg the "Russian Association for the furtherance of the Fishing Industry and Fish Culture." This association is patronized by Grand Duke Lergej Alexandrowitsch; Chamberlain W. von Greig is its president, and Prof. O. Grimm its secretary. The first work of this association will probably be to draw up suitable fishery regulations for Russia. According to Professor Grimm there are in Russia proper no laws whatever to regulate the fisheries, whilst there are some, though of comparatively ancient date, in the Baltic provinces.

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Before passing an opinion as to the advisability of introducing artificial fish-culture in Finland I deem it proper to give a brief review of the present condition of fish-culture in several foreign countries; more especially because the experiences made at Nikolsk during the last 25 years would by no means be considered as encouraging to those who wish to introduce fish-culture in their own country. This applies, however, only if one desires to make fish-culture financially profitable, and does not consider it merely as a pleasant pastime, or as an opportunity for making interesting experiments.

FRANCE.

I begin with France because the impetus for the more general introduction of artificial fish-culture came from that country during the first years of the reign of Napoleon III. Prof. Emile Blanchard, member of the Institute in his work, published in 1866, *Les Poissons des eaux douces de la France*, has given, pp. 571–697, a review of the history of fish-culture in France during the present century, and pp. 610–623, an interesting and instructive *résumé* of the necessary conditions for the well-being and increase of fish, both of which articles appeared in a Swedish translation in 1869, in my "Journal for Fisheries and Aquiculture". I inclose a number of this journal, and take the liberty to direct attention to the two articles in question, p. 33 and p. 74, with the remark that, according to M. J. Clave, *Revue des deux Mondes*, January, 1868, p. 146, the large piscicultural establishment at Hüningen, in Alsace, which, up to the year 1862 had cost the Government about 600,000 francs [$120,000], and where, from 1855–1862, about 30 million eggs of fish belonging to the salmon family had been hatched, had increased the stock of fish in the Seine, Loire, Garonne, and the Rhine only by a few trout and other salmonoids. The interest in artificial fish-hatching which sprang up very suddenly in France, and which soon became very general, diminished in the same degree as the exaggerated expectations regarding it proved vain, and when the Empire fell it had almost died out entirely.

GERMANY.

That branch of industry which the Germans term "pond-culture," which mainly employs itself in the raising, in ponds, of carp and recently also of trout, is of very ancient date. But not till after Alsace had been annexed to Germany, and the French establishment at Hüningen had become the property of the German Government, and Germany had become an empire, did an interest in fish-culture begin to be awakened in Government circles. In Berlin the German Fishery Association was formed under the patronage of the Crown Prince of Germany. As

regards its activity, it must be said that the history of this association is the history of artificial fish-culture in Germany during the last ten years. At the instance and by the aid of the German Fishery Association, the great majority of whose members are high officials, members of the aristocracy, and wealthy landed proprietors, there sprang up, within a short time, many private piscicultural establishments great and small, in different parts of the empire, whose main object was to produce young fish in an artificial way, and by placing them in open waters to stock these anew with fish, and thus to furnish an additional supply of cheap and wholesome food for the large population of the empire. The object was, therefore, altogether the same as that which the Imperial Government of France had in view twenty years earlier. Some idea may be obtained of the extent of the activity of this association when we state that in the year 1880–1881, more than 6,000,000 impregnated fish-eggs, 1,800,000 salmon-eggs, and 2,600,000 eggs of the *Coregonus* were hatched in the establishments of the association. In the following year the number of eggs hatched was 4,000,000, among them 1,270,000 salmon-eggs. The largest and most famous piscicultural establishments in Germany, which sell, at fixed prices, young fry and impregnated eggs, mostly of the salmon and *maräne*, are: the well-known Government establishment at Huningen, in Alsace, under the superintendence of Director Haack; Radolfzell, on the Lake of Constance, and Selzenhof, near Freiburgh, in Baden, both belonging to Mayor Schuster; Lübbinchen, near Guben, belonging to Mr. R. Eckardt, and Berneuchen, belonging to Mr. Max von dem Borne. The above-mentioned gentlemen are at the same time the most famous and most experienced pisciculturists of Germany. During the last five years the German Fishery Association has endeavored to acclimatize various American fish. The beginning was made with the shad (*Alosa præstabilis* DeKay) which is found in very large numbers in the American rivers. This fish in its looks and habits resembles the German may-fish, and the "Wolga herring" (*Clupia caspia* Eich.), which ascends the river Volga from the Caspian Sea in enormous numbers. The attempt to acclimatize it in Germany, however, did not prove successful. At the same time attempts were made to acclimatize in the Danube the California salmon (*Salmo quinnat*, Rich). The attempt to keep these fish alive in some ponds proved successful, but their transfer to the Danube, although made on a large scale, has not been accompanied by any favorable result, nor are the prospects for the future very promising; for it is well known that all attempts made in America to introduce this salmon in the rivers on the Atlantic coast, have proved failures, although the placing of the young fry in the rivers was done under the superintendence of highly experienced and persevering pisciculturists. There have also been introduced in Germany impregnated eggs of the following kinds of American fish: the American fresh-water salmon (landlocked salmon), *Salmo fontinalis* (a kind of saibling), and *Salmo irideus*, as well as a kind of American *Coregonus* (*Coregonus al-*

bus). Young fish have been raised from these eggs, and are carefully nursed in ponds. As all kinds of salmon are voracious fish of prey, and as the above-mentioned American salmon are no better in this respect than those of Germany, the economical result of these experiments, even if successful, which so far cannot be said of any of them, cannot be considered as very great.

As regards the results of the placing in open waters of the young fry of salmon and of other fish of this kind, as well as of *Coregonus*, there are, with the exception of a few trout brooks of which it can be proved that after the placing in them of young fry there was a temporary increase of trout, no data to show that the number of fish have actually increased in the waters stocked. The salmon fisheries in the Weser and the Elbe seem to have improved somewhat; but this may easily be explained by the fact that in Germany, since 1874, the salmon is strictly protected during the spawning season. It is true that Max von dem Borne has spoken of numerous successes, but his assertions have frequently been clothed in very indefinite terms, and are often emphatically contradicted by other authors, and are consequently open to severe criticism. This applies, for instance, to his statement that the number of salmon in the Rhine and in the Oder had increased considerably after they had begun to place annually large quantities of young salmon fry in these rivers and their tributaries. As regards the Rhine he bases his assertion principally on some data relative to the quantities of salmon brought to the market of the Kralingsche Veer in Holland during the years 1870–1880, communicated by firm of Ten Houten & De Raadt. It is said that the number of salmon received at the above place was 21,687 in 1870, and 41,736 in 1880. It should be observed, however, (1), that the nummer of salmon was largest in 1873 and 1874, when the association began its activity, viz, 58,384 and 77,070 respectively, and that it gradually decreased to 38,914 in 1879, and to 41, 736 in 1880; (2), that the supply of one kind of fish in a market, which is not the only one where such fish are sold, depends on so many different circumstances, that an increase or decrease of this supply cannot, even with any degree of probability, be considered as an indication of the greater or less success of the fisheries. It must also be taken into consideration that all along the upper Rhine, especially in the neighborhood of Basle, there are heard numerous and loud complaints that the salmon fisheries in this part of the Rhine have decreased. As regards the lower Rhine, similar complaints have been published in the journals, for instance from the neighborhood of Wesel. In the *Deutsche Fischerei-Zeitung*, No. 28, 1881, p. 230, L. Prenger & Son say in a letter from Wesel, with regard to the salmon fisheries in the Rhine: "People both on the Upper and Lower Rhine complain in the most piteous manner of the poor fisheries;" and in the same journal, No. 42, 1882, October 17, p. 336, it says literally in a communication from Basle: "The result of the salmon fisheries at our fishing-stations during the last four years is not more than 10 per cent. of the results

of the years 1875–1878, and at most of these stations not enough is made to pay two fishermen, as the income from the fisheries barely suffices to pay for the nets." Jacob Glöckner also states, in an article entitled *Vom Rheine* [From the Rhine], published in No. 9, 1882, of the same journal, that the number of fish in the Rhine was much larger twenty to thirty years ago. It is said that for the last fourteen years a large number of young salmon have annually been placed in different parts of the river Oder; nevertheless the editor of the *Deutsche Fischerei-Zeitung* says in No. 41, 1882, p. 330 of that journal, that no increase in the yield of the salmon fisheries can be noticed. It cannot therefore be decided with absolute certainty whether the artificial hatching of salmon has really proved a success in these rivers, as is maintained by the zealous member of the German Fishery Association Max von dem Borne. It is also very remarkable that the German Government, which heretofore had specially favored every enterprise of the German Fishery Association, and which had lent strong material aid to the great international Fishery Exposition inaugurated by the association in 1880, absolutely refused any Government aid to the representation of Germany at the International Fishery Exposition which in the present year is to be held in London, in consequence of which refusal the association has been obliged to give up all idea of being represented at the London Exposition.

The association has recently addressed a petition for aid to the German Parliament, but the finance committee of that body is said to have refused to grant this petition.

AUSTRIA.

Recently several private piscicultural establishments, on the German model, have been founded in different parts of the Austrian Empire, and the young fish hatched in these establishments have as a general rule been placed in open waters. But the largest, most famous, and oldest of these establishments, "The Central Institution for Artificial Fish Culture," at Hellbrunn, near Salzburg, which had been in existence for nearly 17 years, and where annually as many as 3,500,000 fish-eggs, principally of salmonoids, *Coregonus*, and graylings, had been hatched, was closed last year, owing to "slack business." The article which Andrae Schreyer wrote in a piscicultural journal on this establishment, the prospects of which were at one time exceedingly hopeful, is not without interest. The establishment was laid out according to a very extensive plan, no less than 31 ponds belonging to it; and in addition to these the Salzburg Association for Artificial Fish Culture, to which the establishment belonged, owned two large lakes, the Hinter Lake and the Waller Lake. Impregnated eggs and young fry from this establishment were sent far and near, and whatever young fry could not be sold were placed in ponds, lakes, and other open waters. In the beginning, when the interest in artificial fish-culture was still at its height, the estab-

lishment could hardly get enough eggs and young fry to supply the demand; but after a while the demand grew less, so that there was a superabundance of eggs and young fish. The raising of fish in ponds did not prove as successful as desired, the open waters not showing any larger number of fish than before, and, as we said above, the Hellbrunn establishment had to be closed last year owning to "slack business."

UNITED STATES.

During the last twenty years a number of Americans have become famous in the annals of pisciculture, partly by new discoveries in the technical part of fish hatching, partly as practical pisciculturists or patrons of pisciculture. Among these men deserve to be mentioned: Livingston Stone, Seth Green, T. B. Ferguson, C. G. Atkins, J. Williamson, M. G. Holton, F. N. Clark, J. H. Slack, F. Mather, R. E. Earll, M. McDonald, H. C. Chester, and, above all, Prof. Spencer F. Baird. Several States of the Union have fish commissions which, in their various hatching establishments, produce an almost fabulous quantity of fish, which are placed in open waters. Just as in Europe, these fish mostly belong to the salmon and *Coregonus* families, but the Americans also hatch artificially the shad (*Alosa præstabilis*) which ascends the rivers from the sea in large numbers for the purpose of spawning; and recently some salt-water fish have also been hatched artificially. In the year 1877 a steamer, the Fish Hawk, was constructed exclusively for hatching shad. It gathers easily sufficient quantities of roe and milt from a number of fishing stations located at a considerable distance from each other, and takes the young fish to those waters for which they were destined. Steamers are also said to have been used for the hatching of cod, for the purpose of conveying millions of young cod to coasts where they had not hitherto been found.* It is well known that the cod propagates its species in enormous numbers. Its roe develops whilst floating in the water and in one female cod as many as 9 million eggs have been found (*Nilsson*). Attempts have also recently been made to acclimatize foreign fish. Thus the carp has recently been introduced from Europe, and it seems as if its culture in ponds, on the German model, has a future in America. In California and Oregon the hatching of salmon eggs is said to be carried on on a large scale in the McCloud River and the Clackamas River, partly at the expense of the "Association for Preserving and Protecting Salmon," which has given a considerable sum for this purpose. We are informed that in these salmon hatcheries from 14 to 20 million salmon eggs have been hatched in one year.† In Michigan,

* This is a mistake. Only one lot of cod have yet been hatched, and those were released at Gloucester, where hatched. It was a very successful experiment, and the Commissioner hopes to hatch cod on a large scale at the Wood's Holl Station hereafter.—C. W. S.

† The salmon hatched and planted in McCloud have produced remarkable results, increasing the yield of the salmon canneries from 25 to 50 per cent. See accounts elsewhere.—C. W. S.

according to E. M. Miller's statement, 100 million fish-eggs have been hatched during the years 1873–1881, and placed in open waters, but with what results I have not been able to learn with absolute certainty. The same applies to American fish production in general, with exception of the shad culture, which has been successful in so far that the shad is now found in rivers where formerly it was unknown.

CANADA.

In 1865 Mr. Samuel Wilmot began to introduce artificial fish-culture in Canada. At Newcastle, in the Province of Ontario, where he resides, he established a salmon-hatchery, which soon gained considerable reputation. This was acquired by the Colonial Government and extended in 1869. Mr. Wilmot has gradually succeeded in founding, at Government expense, several similar establishments for raising the American maräne, the whitefish. The number of these establishments in 1880, according to Raveret-Wattel, was 7, and according to E. M. Miller, 10, kept up at annual expense to the Government of £5,000. Mr. S. Wilmot is the director and superintendent of these establishments. It is his aim also to produce as many young fish as possible. The entire quantity of fish eggs hatched in all the Canadian establishments till the end of the year 1880 is estimated at 200,000,000. The number hatched in 1880 was 26,000,000, divided as follows: 18,000,000 whitefish, 4,000,000 salmon, 4,000,000 lake trout, and 125,000 brook trout. From these 26,000,000 eggs there were obtained 21,500,000 young fish, which were placed in open waters. All the above information is given by E. M. Miller, member of the Michigan Fish Commission. As regards the practical results of this enormous production of young fish, we possess no reliable data. Miller says that the number of *Coregonus* had increased in the Detroit River; but it cannot be ascertained whether this increase holds any reasonable proportion to the large sums annually spent for producing young fish. I know from personal observation, however, that after fishing had been strictly prohibited for a certain period in autumn, the number of *Coregonus* in some of our Finland rivers increased very considerably. The quantity of fish caught annually in any body of water is, moreover, not the same every year, but is subject to great changes which are beyond human control.

ENGLAND, SCOTLAND, AND IRELAND.

For many centuries Great Britain has sought to preserve and increase the stock of fish in her rivers by strict legislation, and especially by rigid protective measures; these endeavors have been successful, and there is at present no country in Europe whose salmon-fisheries could vie with those of Great Britain. Artificial fish-culture has also been attempted in Great Britain, more than twenty years ago. Even quite recently some private hatcheries have been established, but artificial

fish-culture has never been one of the prominent British industries, and the Government has never appropriated a single penny for this cause; for experience had shown that strict and continued protection of all fish belonging to the salmon kind, at least during their spawning season, is the most efficient and only safe means of preserving and increasing the stock of fish in the rivers. Among those persons who have recently evinced great interest in fish-culture, the Duke of Sutherland deserves special mention. He is said to possess several model establishments for hatching salmon, in which as many as 800,000 eggs can be hatched per annum. Since 1873 he places every year more than 500,000 young fish from his establishments in various waters, among the rest in Loch Brora, on whose shore his largest hatchery is located. Although the number of fish annually caught in this lake has not increased perceptibly, it has been found that the breed has been improved, which is supposed to be owing to the employment of select breeders from the Tay, the Tweed, and the Rhine. Some English pisciculturists principally aim at producing a superior quality of fish by crossing the breeds, as is done with domestic animals, and, according to their own statements, they have been successful. There are also in Great Britain large trout-hatcheries carried on on business principles. The principal ones are those of Sir James Maitland, in Howietown, near Stirling, where, besides large quantities of shell-fish, the flesh of at least three horses is used per week for feeding the trout. Mention should also be made of Mr. Joseph I. Arminstead's Troutdale fishery, near Keswick, in Cumberland, and Mr. Charles Capel's Cray fishery, near Foots-Cray, in Kent.

NORWAY.

In Norway, where the fisheries form one of the principal industries of the country, a good deal of attention was given to artificial fish-culture thirty years ago, both by the Government and the public, in consequence of the impetus given by France. According to official data, there have been started in Norway since 1856 no less than about 240 private piscicultural establishments, one-third of which were devoted to the hatching of salmon eggs, and two-thirds to the hatching of trout and *Coregonus*. But a very large number of these establishments, after having been in existence for a shorter or longer period without being able to show any result whatever, were gradually closed; so that during the winter 1878–1879 only 38 were still in operation—16 for salmon, and the rest for other fish. The majority of these 38 establishments were comparatively small, and only 5 of them produced about 100,000 young fish apiece. Although for a number of years 1 to 1½ million young salmon had been produced annually, it appears from the statement of Mr. A. Landmark, inspector of fisheries, in his financial estimate for last year, that there are no absolutely certain proofs that the salmon-culture has so far proved any benefit whatever to Norway. In his observations accom-

panying the draft of a new "law for protecting salmon and lake trout," dated Septemder 16, 1881, Mr. Landmark says very emphatically, on page 66: "It is but too certain that the number of salmon in our country is, on the whole, smaller at the present time than in 1848, when we got our first law for protecting the salmon-fisheries." Mr. Landmark thinks that the production of young fry of the salmon in Norway has been carried on on too small a scale, and that this is the cause why the rivers do not contain more salmon. Following up this idea, and evidently influenced by the reports of the enormous production of young fish in the United States of North America and Canada, he urged the Government to found a large salmon-hatchery on the Topdal River; but the Norwegian Government did not deem it proper to lay a proposition to that effect before the Storting [Norwegian Parliament], at least during the session of 1882. Relative to the fisheries in the interior of the country, especially the trout-fisheries, Mr. Landmark declared, February 5, 1881, at the meeting of the "Norwegian Association of Huntsmen and Fishermen," that the fisheries had been more productive in olden times than at present, and that only in a few places there had been some slight improvement in consequence of various measures taken recently by the Government and by private individuals; and yet there had been in operation in Norway, since 1856, for a longer or shorter period, about 150 piscicultural establishments, founded for the avowed purpose of improving the fisheries in the interior of the country!

SWEDEN.

At the same time as in Norway, considerable interest was also taken in pisciculture in Sweden, and a large number of great and small establishments were founded. Near Östanbäch, at the mouth of the Angerman River, the Government established a so-called "Normal Institution of Fish-culture," in which instruction was given; but after having been in operation for 18 years it was closed, and has not been opened again. Pisciculture in Sweden has not been able to show any very considerable econmical advantages, and during the last ten years the interest in this cause has been on the wane. More recently, especially since the Berlin Fishery Exposition of 1880, the interest in pisciculture began to revive, and at present a number of salmon-hatcheries are in operation on several Swedish rivers, among others in the Ljusne River, the Dal River (Elfkarleby), the Klar River, the Lagaå, the Nisson, and others. Granting the impossibility to regulate, on a large scale, the quantity of fish in open waters by means of pisciculture, the superintendent of fisheries, Dr. R. Lundberg, nevertheless favors the artificial production of fish because he sees in it "an important aid to prevent the decrease of fish, which is invariably brought about by the increasing number of fishermen, by manufacturing establishments, by rafting, &c. "Several economical associations in the provinces have, for the last thirty years, paid persons to instruct the masses on the subject of fish-culture and rational

fisheries, and it is stated that the activity of these teachers of pisciculture "promises well for the future." As far as I know, it is impossible, after thirty years of artificial fish-culture, to show any increase in the quantity of fish in the open waters of Sweden; but it seems that, so far at least, the Swedes are determined to continue their efforts in this direction. In 1879 a landed proprietor in Schoren [the most southerly province of Sweden] commenced to raise carp in ponds; and there is a reasonable prospect that this kind of fish-culture, if carried on rationally and cautiously, will prove profitable, because the carp can easily stand the climate in the southern part of Sweden.

FINLAND.

As regards our own country, artificial fish-culture was advocated here more than a hundred years ago, by Magister C. R. Gjers, in a treatise published by him at Åbo, in 1771, "On the causes of the decrease of the Government salmon and *Coregonus* fisheries in the river Kumo," but as far as known, without any practical result. In consequence of the impetus given by France, however, earnest efforts were made during the years 1858–1867 in behalf of fish-culture. During the period 1858–1862 a number of private individuals started various piscicultura lestablishments, under the guidance of my predecessor, H. J. Holmberg, who had studied the organization of such establishments in Norway. The most important establishments of the kind were in possession of the following persons: Stockfors, on the Kymmene River, owned by Counsellor Schatelowitz; Abborfors, on the same river, by Major-General Clayhills; Hovinsaari, in the district of Kymmene, by Mr. Druschinin; the establishment in the neighborhood of Kexholm, on the Wuoksen River, by Mr. Lebedeff; the one on the Urpala River, in the Wiburg Government, by Mr. Alfthan; the one near Tammerfors, by von Nottebeck; the one at Svartå, by Baron F. Linder; and the one in the District of Kronobarg, by Rev. Mr. Hartman. The three last mentioned establishments raise principally brook trout and lake trout. During the years 1863 and 1864 two large salmon-hatcheries were established by associations of salmon-fishers, the one on the the Uleå River, and the other on the Torneå River. For a number of years these establishments have annually placed a large quantity of young fish, principally salmon, in the rivers on whose banks they are located; thus the establishments on the Kymmene, Uleå, Urpala, and the one near Kexholm, have annually placed as many as 100,000 young fish apiece in open waters, the Kexholm establishment during one year even as many as 200,000, without any noticeable increase of the quantity of fish in any of the above mentioned rivers. The production of young fish, therefore, gradually ceased in all these establishments; and the result of these earnest endeavors, made at considerable expense, was altogether a negative one and did not induce people to imitate them. The great expectations which had been raised in Finland, as in other countries of Europe, with regard to the artifi-

cial production of young fish, were here, as elsewhere, doomed to disappointment.

Fish-culture, in the widest sense of the term, embraces (1) fishery legislation, (2) pond-culture, (3) transplanting fish, and (4) production of young fish in an artificial manner and the placing of the young fish in open waters, or what is known as artificial fish-culture.

Fishery legislation forms in all countries an object of serious attention of the government and the legislative bodies. It aims at maintaining in open waters all those conditions which are necessary for the propagation, increase, life, and well-being of fish. In Finland this legislative work did not commence till 1786, when excellent fishery regulations were promulgated; and after the fishery regulations of the year 1865 were made, the work went on uninterruptedly by making various local laws securing the protection of certain species of fish during the spawning season, as well as the manner of superintending the waters and regulating fishing in such a manner as to sufficiently protect the propagation of fish in the natural way, to protect the young fish, to prevent any impure or poisonous matter from getting in the water, and to secure all those conditions which are necessary for the well-being of the fish and the reproduction of food in so far as this is dependent on the aquatic vegetation, &c. I venture to say that Finland has not been backward in this respect, although many gaps are yet to be filled, and many improvements in the details will have to be introduced as greater experience is gained.

The pond-culture of the Germans—that is, the raising of certain kinds of fish, especially carp, in ponds—is, as far as I know, in no part of Germany an object of direct care of the state, but is left entirely to private effort. According to a statement by P. Dabry de Thiersant, the Chinese only raise fish living on vegetable food; and these fish are raised from roe impregnated in the natural way and gathered in the rivers. In Europe the fish which are principally raised in ponds are carp, which live on vegetable matter, and, though to a less degree, brook trout and fresh-water trout and saibling, partly in ponds and partly in brooks. As these last mentioned kinds of fish are found in Finland, it must be supposed that it would be possible for us also to raise them in ponds; but whether it would be a source of profit is another question. These fish require exclusively animal food, flesh or fish, which makes their support quite expensive, so much so, in fact, that it will only pay in localities where fish fetch a very high price. It has been calculated that it requires 5 kilograms horse flesh or other flesh, or a corresponding quantity of fish, to raise 1 kilogram trout. German trout-culturists get as much as 4 marks (95 cents) per pound for their trout, and with such prices this industry of course becomes profitable. Mr. A. Haldenwang, proprietor of the well known piscicultural establishment at Gaisbach, near Baden-Baden, says, in his report for 1881, that he gets from 3 to 5 marks (71 cents to $1.19) per pound for his trout. Our long and severe winters, last-

ing from six to seven months, and great variations in the depth of the water, would moreover place great difficulties in the way of successful trout-raising, and would still further increase the expense. As regards the carp, which, in central Europe, is raised cheaply and with comparative ease, I believe that, in view of our climatic conditions, it would not pay to raise carp in Finland. The northernmost countries where carp culture is regularly and successfully carried on are Holstein and Courland. Even in Schleswig people complain of lack of success in carp culture. Carp were centuries ago, introduced in Schonen, the southernmost province of Sweden; but they are not found farther north in Sweden. All the attempts of King John III to raise carp on the island of Öland have proved futile. In Norway the carp has been acclimatized in only two places, viz, near Farsund, in the southernmost part of the country, and at Milde, near Bergen. According to Grimm, carp are said to be found near St. Petersburg, in some of the ponds belonging to the Imperial country seats, and, according to Kessler, also near the Convent of Walamo, but there is no attempt made at carp culture. Carp were first introduced in Finland in 1861, when Chamberlain Baron von Linder placed some in a pond on his estate of Svartå, but they are said to have died out after a few years. Attempts in this direction had also been made prior to 1861, but likewise without result. The carp requires constant care and protection, just like a domestic animal, for, in spite of its enormous power of propagation—a large female carp producing as many as 1,200,000 eggs—it will not be able after having been domesticated for centuries, as it has been in Central and some parts of Northern Europe, to successfuly compete with other fish in open waters in the battle for existence. As I remarked above, attempts to raise carp have been made in the Swedish province of Schonen since 1879.

The stocking of waters with certain kinds of fish by transferring the young, and the attempts to acclimatize fish, have in no European state been made directly by the Government, but they belong entirely to private enterprise, or are managed by societies or associations formed for the purpose. In Finland this way of carrying on fish-culture has been common for a long time, and during the last twenty years fish have been successfully transplanted in considerable numbers. The interest in such attempts among our people is by no means on the decrease, but is, on the contrary, very lively, especially since the Imperial Senate, in 1879, commenced to award small annual prizes for the successful and profitable transplanting of fish. More than fifty such awards have been distributed during the last four years, principally among the peasants; and in several cases the transplanting of various specimens of *Coregonus* has proved a decided benefit to entire villages and communities. As the transplanting of fish, either by means of impregnated roe or young fry, or by mature spawners and milters, is so easy a matter that even peasants, who may otherwise not be very bright, can do it, I do not consider it necessary that the

Government should take special measures for furthering this kind of fish-culture.

As regards fish-culture proper, artificial fish-culture, which consists in the production of young fish in special establishments and the placing of these young fish in open waters, the opinion has now very generally gained ground in Europe that it is entirely useless to apply this kind of fish-culture to those kinds of fish which spawn in spring and summer. They are endowed with such a powerful faculty of propagation, and their impregnated roe develops in so short a time, that wherever the necessary conditions for their well-being exist, sufficient young fry is produced by nature's own activity, in a much safer way than man can do it, if only care is taken that there is a sufficient number of mature spawners and milters and suitable spawning-places. One of the most competent authors on this subject, Mr. H. Haack, director of the German piscicultural establishment at Hüningen, says in his official Reports on the Berlin International Fishery Exposition of 1880, page 34: "I have, for twenty years, made exhaustive experiments in artificially raising most of those fish which spawn in summer, and in most cases I have succeeded in raising a few thousand young fish of these kinds; but I have nevertheless arrived at the conviction that all efforts made in this direction have been mistakes, for even in the smallest open spawning-ponds a hundred times more favorable results were obtained than by the most careful artificial culture."

The quantity of fish in any body of water is always in direct proportion to the quantity of suitable food for the fish in their various stages of development; but this quantity of food, though different in the different waters, is always strictly limited by nature; and it is not often in the power of man to change this proportion for the better. It is, therefore, impossible to make any water produce a larger quantity of fish by the artificial hatching of young fish than the quantity of food which it is able to produce entitles it to, no matter how large the body of water. It is by no means the number and size of the various bodies of water in a country which determine the quantity of fish in that country, but the quantity of suitable food which is produced in its waters.

As will be seen from the above review of the present condition of artificial fish-culture, it is only those fish which spawn in winter, the salmon and other salmonoids, as well as some fish of the *Coregonus* family, which both in Europe and America have formed and still form the principal objects of cultivation in special esta blishments. Although the cultivation of these kinds of fish in Europe has been carried on for thirty years, in some countries even on a very large scale, we have no positive proof from any European state that this cultivation has, to any noticeable degree, increased the quantity of fish in the open waters, with the exception of a few trout-brooks, or that it has brought finan-

cial results commensurate with the expense, or that it has become a matter of great public importance. It is true that, in some cases, artificial fish-culture has made it possible to transplant some kinds of fish to countries and waters where formerly they were not found, and that in other cases it has facilitated this transplanting process, but these results possess more of a scientific than of a financial interest. It is absolutely certain that in countries where the most persistent and the strongest efforts have been made to increase the quantity of fish in the open waters by producing young fish in an artificial manner, as in France and Norway, the hopes entertained of the economical importance of artificial fish-culture have been thoroughly disappointed. I purposely refrain from speaking about artificial fish-culture in America, because I am not sufficiently acquainted with the condition of affairs in that country, and have not been able to obtain any reliable information on the subject, and finally because the experience gained there seems of too short a date for forming any definite opinion. Suffice it to say that in Europe artificial fish-culture has left nothing but disappointed hopes, and in many cases even considerable financial losses. Under these circumstances, and as in the whole of Europe there are on the one hand about 500 private piscicultural establishments, but on the other hand only three such establishments supported by Government funds, the German one at Hüningen, the Russian one at Nikolsk both of which, as we have seen, have cost enormous sums and have been of little use—and the one at Engelstein on the Chiem Lake in Bavaria, a small establishment for raising lake-trout, I do not feel justified in advocating the establishment at Government expense of institutions for raising young fish in an artificial manner; all the less because 15 to 20 years ago people in Finland made very earnest, but also very fruitless endeavors in this direction. I would also mention in this place that a meeting of fishermen, pisciculturists and friends of the fisheries, called by the Austrian Fishery Association, and held in Vienna, April 29 and 30, 1882, under the auspices of the Austrian ministry of agriculture, answered one of the questions which came up for discussion, viz, "Is it desirable to found piscicultural establishments at the expense of the Government?" in the negative.

If, however, the Imperial Senate should feel inclined to order further experiments in artificial fish-culture in Finland, I am of opinion that we ought to use a method of hatching roe which saves more space, and, above all, which is cheaper than the one employed at Nikolsk; and I would recommend the well-known Norwegian method, which has been found to answer the purpose in every respect, or, still better, some more modern method, for instance, with the California or Williamson's hatching-boxes, which has been tried in Sweden and Germany.

63.—A VERDICT AGAINST ARTIFICIAL FISH-CULTURE, AND AN ANSWER THERETO.*

[From "*Deutsche Fischerei-Zeitung*," Vol. VI, No. 15, Stettin, April 10, 1883.]

Professor Malmgren, inspector of the Finland fisheries, at the request of the Imperial Senate of Finland presented a memorial on the 20th January last to the Agricultural Commission of that body, as to the advisability of introducing artificial fish-culture in Finland, and, more especially, whether the method followed at the piscicultural establishment of Nikolsk, situated in the Government of Nowgorod, could be applied in Finland. A German translation of this memorial, printed by J. Simelü's Heirs at Helsingfors, has been sent to us. It is a remarkable document, principally because it is the first instance in the literature on fisheries of an author almost entirely denying the results of fish-culture, at least as carried on at present. Dr. Malmgren speaks freely, and without the slightest reserve, what he thinks. He has no praise to bestow, but says in other words that, as far as his experience and his information go, the results of fish-culture almost amount to nothing. His advice is, therefore, not to introduce in Finland such useless and expensive establishments, as they do not pay. Is he right? That is the question. Following his instructions, the professor first of all visited the remote establishment of Nikolsk. He there found a vast and expensive establishment for hatching millions of eggs, whilst the annual production of 100,000 to 200,000 eggs was no more than is produced by a second-rate German establishment; 100,000 to 200,000 roubles have been lost; the founder—once a wealthy man—has become a pauper, his successor became a bankrupt, and now the Government has taken the establishment, which is under the superintendence of a learned gentleman. The thing did not work, it does not work now, and it never will work. The men who founded the establishment were mere theorists who had no practical knowledge of nature. The spawning fish had to be brought a distance of 350 wersts [233 miles]; there is plenty of water in the neighborhood, but none which is suitable for the young fish. The young fry of trout and *Coregonus* (*maränen*) have been placed in lakes, in large numbers, just as with us; but they only became food for other fish; hardly any were caught again. No wonder: out of 100,000 embryos nature sometimes allows a few to reach maturity, but very often she does not let any reach that point, for she cannot provide the food necessary for so many mouths. The theorists never thought of this. Of what use are sterlets in a lake, or *lake Coregonus* in a river? Propagation is not to be thought of under the circumstances. Occasionally fish of some new kind were made to flourish in a lake, but not

* "*Ein Verdikt gegen die künstliche Fischzucht und eine Antwort darauf.*" Translated from the German by HERMAN JACOBSON.

by placing in it young fry, but grown fish. Smelts were placed in a lake, where these fish had heretofore not been found; they flourished and increased wonderfully, but since that time the number of bleaks and other fish has been diminished, the yield of the fisheries has not been increased by a single pound, and no progress has been made; a certain proof, says the professor, of the great truth which for so long a time we have preached in vain, that a body of water cannot produce any more fish than the quantity of suitable food contained in it entitles it to. The superintendent of the Nikolsk establishment confessed to Professor Malmgren that a few hundred trout and *Coregonus* in the ponds of the establishment were the only visible result of its 25 years' existence; and that all these fish, if brought into the St. Petersburg market, would not fetch enough money to pay the expenses of the Nikolsk establishment for one year.

If we were to judge fish-culture from this establishment, we would most assuredly do better to shiver our hatching-pots into atoms, to use the wood-work of our hatching-houses as fuel in our bake-ovens, and simply leave fish and fish-culture alone. The professor, however, does not base his unfavorable opinion of fish-culture only on the above-mentioned Russian failures, but also on experience gathered by him in countries having a far higher civilization than Russia; and it must be granted that he has drawn his information from numerous sources, and that he has critically sifted all the material he could lay hold of and used it in such a manner as to serve his preconceived opinion. He refers to several articles in our journal, according to which—in spite of all reports to the contrary showing an increase of salmon in consequence of the placing of young fry in open waters—the number of salmon had materially decreased. The professor does not state, however, that in many other articles contained in our journal we have given favorable reports, and that at no time we have denied the vitality and usefulness of fish-culture, if properly managed, whilst he condemns it entirely. In reviewing the efforts made by various countries, the professor does not arrive at any more favorable result. Among the rest, the efforts made by us in Germany, especially those of the German Fishery Association, appear to him entirely futile; and as to the reports of the German Fishery Association, he regards them as rose-colored and unreliable. Truly a harsh and discouraging opinion, if the professor is right. But, fortunately, matters are not quite as bad as he makes out. Exaggerated hopes have doubtless often been based on mere accidental occurrences, and people have begun to exult too soon; doubtless, those incalculable figures which nature uses in her arithmetic of the birth and death of aquatic animals have more or less been left out of the account by many of our pisciculturists; and life and death in the water has, theoretically, been forgotten; very probably the outlay of labor and money will, even at the present time, hardly correspond to the results; but all this does not justify us in deprecating the efforts made by our Fishery Associa-

tion, and in giving up all hope of a favorable result for the future. The aristocratic and learned members of the Berlin committee are probably not all practical men in every respect; all they could do was to give a more general impetus to fish-culture; and whenever the carrying out of their theories, especially the placing of young fish, was not based on a thoughtful and persevering observation of nature and her laws, the results could, of course, not be very great. At the same time it cannot be denied—and in this respect the professor's information has been defective—that wherever practical men have taken the matter in hand, as in Schleswig-Holstein, where people go slow but sure, and without making a great noise about their achievements, highly favorable and unquestionable results have to be chronicled. The strong impetus which has been given by the committee of the German Fishery Association has most assuredly been beneficial. Results will come in time, and, as more practical experience has been gained, people will only make efforts when they are tolerably sure of success, and theoretical experiments, which lead to nothing, will be abandoned. Thousands of young fish will not be placed in waters which have the full quota of fish to which their quantity of food entitles them, unless the number of fish has previously been considerably diminished by fishing. Expensive young fish will not be placed in waters where, during the first few weeks, they must be destroyed by other fish; but the young fish will, for a year at least, be assigned some water where they are protected from their enemies, and where they will live till they have reached a sufficient age to be beyond many of the dangers which threaten them in their infancy. Young fish will only be placed in waters where, according to reliable calculations, observations, and experience, they will grow and flourish. The young fish needed will be raised artificially, and an income will be secured thereby; the results will come at last. We should endeavor to learn and gather new experience as we go on. No one will ever cease to learn—neither the committee, nor we, nor Professor Malmgren. And in order to learn this wholesome truth, a lack of recognition and a harsh criticism are what we need. We are confident that, in spite of many mistakes made by the committee (especially in the matter of legislation), and in spite of future mistakes which doubtless will be made, the self-sacrificing and disinterested activity of the committee will ultimately prove a benefit to our German fisheries. It is not only Germany which is thus severely criticised in the professor's report, but, in his opinion, fish-culture has been absolutely without results in France, Austria, Norway, and Sweden. Only as regards America and England, the professor confines himself to a statement of what has been done, without saying anything about the results, probably because unfavorable reports have reached him from these countries.

Professor Malmgren's pamphlet will—unless treated with silent contempt—make a considerable stir in Germany and Austria, and any country which has numerous hatcheries. Even at this early stage of

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the controversy we are enabled to communicate the following letter addressed to Professor Malmgren, by R. Eckardt, of Lübbinchen:

My best thanks for your pamphlet. I fully subscribe to everything you say relative to the establishment of Government hatcheries, but I take the liberty to call your attention to another kind of Government action, which for ten years—so far, unfortunately, in vain—I have striven after: the institution of scientific stations in connection with private piscicultural establishments. There is in Europe at the present time but a single institution of this kind—the one at Naples, conducted by Professor Dohrn (only, however, for maritime purposes)—which renders great service to science, but probably would be only of small financial benefit to us. If in the various countries of Europe, differing from each other with regard to climate, we had such scientific stations for the inland waters, their scientific investigations would have a great practical result. One of the first and principal conditions of success is the practical management of affairs, which should be able to furnish the necessary material for scientific observations, and which, hand in hand with science, knows how to practically utilize, for new results and discoveries, all the achievements of science. A vast field like fish-culture cannot be properly and advantageously worked by either science or practice by itself, but needs their combined efforts.

Artificial hatching is particularly important for fish which spawn in summer, and will, if managed practically and rationally, be productive of good results in our, as to climate, favorably located waters, and our pond-culture will derive great benefit therefrom, principally with regard to carp, tench, bream, pike, etc. I can here record results which will compete with those obtained in other countries, but which simply lack the benefits of scientific investigation, which would make progress easier. Fish-culture is a vast field, which needs the scientific observations of years, to be properly studied, and be made profitable for practical life and the wants of man. When, in 1878, I asked Professor Pagenstecher, of the Heidelberg University, what was the reason why the mayfish carried so many spoiled eggs, he replied that he would be exceedingly glad to investigate this matter, but unfortunately he did not have the necessary material. This I procured for him at once, but so far, at least, I have not received an answer to my inquiry. If the German Government were to apply the sum annually required for the support of the Hüningen establishment—25,000 marks [$5,950]—which is of no practical benefit to the establishment of one scientific station here, on my estates, the entire civilized world would be greatly benefited thereby, and scientists would soon take a greater interest in the matter. My establishment raises various kinds of fresh-water fish, and has a lake area of 400 hectares; it is not subsidized by the Government, but stands, so

to speak, on its own feet; and in spite of many expensive experiments and improvements it has been successful, and its usefulness is capable of still further extension. There is no doubt that we shall also see financial successes, for the achievement of which, however, scientific investigation will be absolutely required. As the result of all my observations I can state, from firm conviction, that the quantity of fish in any body of water suited to fish culture, can be enormously increased by stocking it with fish-spawn in due proportion to the peculiar qualities of such water, and this should not be left to accident, if any benefit is to be obtained therefrom. Every fisherman here knows this, as all of them practically carry out this idea. These people have to buy the fish-spawn, and often have to transport it a considerable distance with great difficulty, but they shun neither expense nor trouble in order that they may in later years derive a certain benefit; and they thus stock the lakes which they have bought, or which they rent—not to mention the ponds, with regard to which this mode of procedure is under stood.

If the stock of migrating salmon in the rivers cannot be controlled, this is a circumstance which will render it difficult to prove anything with absolute certainty; but we have, as is shown by the appearance of enormous quantities of salmon in the Weser and Elbe during the last years, obtained results which can be traced to nothing but the artificial stocking of the waters with young fry. It is impossible to state, in exact figures, the number of salmon annually caught near Hameln during the last twenty years, or the number of salmon annually caught near Bremen during the last three years; but the rent of the Hameln salmon-fisheries, which previous to 1862 was 900 marks [$214.20] per annum, had in 1877 increased to 15,000 marks [$3570], and has, as far as I know, increased still more. In the autumn of 1881 so many salmon were caught near Bremen that they sold at 50 and 60 pfennig [11 and 12 cents] per pound. This must, certainly, be considered a favorable result of the artificial stocking of the waters. Unfortunately we do not know what is done in this direction in the Netherlands. The river Oder is no longer adapted to stocking with salmon on a large scale. Artificial fish-culture and the artificial stocking of the waters with salmon and salmonoids has been accompanied by excellent results in Holstein and along the eastern coast of Germany; and the same applies to trout, and to the raising of carp in ponds. At the present time a single carp-raiser brings an entire car-load of carp to Berlin every week; and he also proposes to supply the Berlin market with large quantities of trout and sea-trout. These are assuredly favorable results of fish-culture which cannot be argued away. It is of course impossible for me to state whether such a stocking of waters with fish would pay in Finland, with whose waters I am not acquainted; but as long as I have obtained favorable results, even without the hope of a reward, as in Finland, in stocking my waters with the spawn of *Coregonus* and bream I should think that, if intelligent men would take the matter in hand in Finland, which, to judge from

the map, has a superabundance of lakes and rivers, greater results than hitherto could be obtained. Even if the fish did not fetch a very high price at home, they could be exported, if not fresh, at least smoked salted, or frozen.

If France, with whose circumstances I am but imperfectly acquainted, cannot show any great results of fish-culture, although it has been carried on here for a longer period than in any other country, this certainly must be owing to the methods which are followed. If anything is to be accomplished in fish-culture, practice must go hand in hand with science. As far as my superficial knowledge goes, the professors wanted to manage everything in France; but this will not do. What are needed are men of practical experience, who devote themselves to fish-culture intelligently and with some degree of enthusiasm.

I would recommend that if somewhere in Finland you have an intelligent landed proprietor, in some suitable locality, a private piscicultural establishment be started on his estates, and that you aid such a man, whenever he needs aid, with the light of your knowledge. Even if the immediate profit should be but small, it may increase in time. At any rate it will pay to go to all this trouble; whilst this cannot be said of a Government establishment.

64.—AN OPINION REGARDING THE ANSWER OF R. ECKARDT TO PROFESSOR MALMGREN.*

By CHAMBERLAIN von POLENZ.

Mr. Eckardt proves, by striking figures, that Dr. Malmgren is wrong, when, in his pamphlet, he says: "Germany's efforts in fish-culture, and more especially those made by the German Fishery Association, have led to no results whatever, and the reports of the committee of that association are highly colored and unreliable." In the course of his remarks Mr. Eckardt condemns all Government piscicultural establishment, in general, and that of Hüningen in particular, saying, among other things: "The Imperial piscicultural establishment at Hüningen is of no practical use whatever."

When Mr. Eckardt, a leader in matters pertaining to fish-culture, publicly pronounces such an anathema, it appears desirable for many people who take an interest in fish-culture that Mr. Eckardt should give the reasons for his view more in detail than he has done in the article referred to, in No. 15 of the *Fischerei-Zeitung*.

Stimulated by the example of the Hüningen establishment I have, since 1853, given close personal attention to fish-culture, and have with great interest followed the development of the Hüningen establishment from year to year, and have thereby gained the conviction that that

* "*Eine Ansicht über die Antwort R. Eckardt's an Professor Dr. Malmgren,*" in the *Deutsche Fischerei-Zeitung,* Vol. VI, No. 17, Stettin, April 24, 1883. Translated from the German by HERMAN JACOBSON.

establishment, by stimulating and furthering the science of fish-culture, which formerly had been but little known, and by guiding the business of fish-culture, which had not been carried on in a rational manner, has been of excedingly great use, and might, under changed circumstances, be of still greater practical use in the future.

The usefulness of this establishment is certainly only in an indirect manner an economic one, whilst a well-conducted private establishment may be of more direct economic use. This is owing to the difference of character existing between Government and private establishments. Whilst private enterprise endeavors, with all the means at its command, to obtain direct profit in the shape of the highest possible interest on the money and labor expended, the Government has other and more general objects in view than annual interest, and may nevertheless benefit greatly the country and its citizens.

To return to the Imperial German piscicultural establishment, it is my opinion that in future it would be of much greater practical use to us if, instead of being located at the extreme southwest end of our country, it was placed in a more central position, nearer to the Weser, Elbe, Oder, and the numerous lakes of the North German plain. In that case the many valuable products of this establishment would be of greater use to us than now; as at present foreign countries actually derive greater advantages from the Hüningen establishment than our country. Owing to local conditions most of the young fish from the Hüningen establishment go into the Rhine, the Danube, and the Rhone, thus being practically of very little benefit to Germany, the Netherlands, France, Switzerland, and the Danube countries enjoying the fruits of German money and German labor.

If our Government piscicultural establishment were located more in the center of Germany its scientific investigations and experiments would exercise a more direct influence and on wider circles in Germany, by stimulating and educating our fish-culturists, than is now possible while the establishment is located near the boundaries of France and Switzerland. By a change of location the piscicultural establishment might be brought in closer and more beneficial contact with the Government and the German Fishery Association than is possible now, the distance between Berlin and Hüningen being so great.

After having given my opinion on our Government piscicultural establishment, I will only briefly remark that what I have said is by no means intended as an objection against the establishment of a scientific station at Lübbinchen. By frequent personal observations I have become well acquainted with the exceedingly practical management of Mr. Eckardt's establishment, and with its great productiveness and its capability of extension, and I am fully convinced that a scientific station at Lübbinchen and a Government piscicultural establishment located somewhere in the center of Germany can very well exist side by side, and would both render highly valuable service to scientific and practical fish-culture.

65.—FRESH-WATER SPONGES: WHAT, WHERE, WHEN, AND WHO WANTS THEM.

By EDWARD POTTS.

The purpose of this article is to give to the uninitiated some idea of the appearance of fresh-water sponges; to suggest where they should be looked for and when it is best to collect them.

It seems to be a fact that very many persons, not excepting some of scientific tastes, are unaware of the existence of sponges in our fresh waters. This may be partially explained by the further fact that in England, and throughout Continental Europe, the keen eyes that for years past have been searching every body of water for its *minuter* organisms, have thus far failed to discover and describe more than two species of sponges. The zeal, therefore, enlisted in the search for them has been far less than the puzzling character of their organization—upon the border-land of animal and vegetable life—and the beauty and quaintness of form of some of their component parts would seem naturally to invite. It is to be hoped, however, that the far richer fauna which has already been developed in America, with the strong probability of a considerable increase in genera and species in the near future, may stimulate observers to aid in this interesting work.

It is not the present intention of the writer to give either a scientific or popular description of these sponges; but only by a few words to help those whose interest may be awakened in the subject, to seek them intelligently and to recognize them when found.

First, then, all fresh-water sponges which have been described at the present date are of a silicious character; that is, their skeleton structure or frame-work does not consist, as in the familiar marine sponges of commerce, of an elastic net-work of tough fibers—but of lines of fasciculated flint-needles, about one $\frac{1}{100}$ of an inch in length, so arranged as to form a loose intertexture, penetrated by canals, and supporting the sponge-flesh. When crushed, therefore, this texture is permanently destroyed and will not resume its original shape. The sponge-flesh, so called, is a thin slime covering the spicules and lining the canals of the living organism; having a peculiar and not unpleasant odor when fresh, but betraying its animal nature by an extremity of foulness when the dead sponge has been kept a few days in water.

Many of the species, native in this country, appear as mere incrustations of varying size and shape, and from less than a line to an inch or more in thickness. Their surface, smooth or more or less tuberculated, is, in some species, supplemented by a higher growth of branches or finger-like processes, frequently several inches in length. In color they vary from nearly white to the most vivid green, in an almost exact ratio to the degree of light received. The slimy growth of Confervæ occasion-

ally seen upon the bottom of pools and streams, or dense masses of water-moss, may momentarily mislead the collector; but a pocket lens will reveal to him at a glance the minute leaves of the moss, or the delicate green threads of the algæ; while in the true sponge he will hardly fail to see the characteristic pores penetrating its surface and to detect the fine points of numerous projecting spicules.

The particular feature distinguishing fresh-water from marine sponges is the presence in the former, when mature, of the reproductive bodies known as statoblasts or statospheres. These are nearly spherical, light or dark brown, generally easily visible by the naked eye, and occupy positions at the lower surface or throughout the mass of the sponge. They should be carefully looked for and gathered with the specimen, as it is upon the form of the spicules encrusting their surface that the classification of fresh-water sponges principally depends. Either very early or very late in the season minute groups of these statospheres may often be found, unaccompanied by the skeleton spicules and slime-like flesh of the sponge, and it is well worth while to gather and preserve them.

These sponges are found growing upon any supporting substance except mud, and at every depth beneath the surface of the water; but they affect chiefly the under and upper surface of stones and timbers, the sides of piling, and of submerged stumps and branches. The stems and roots of water plants are often coated and matted together by them. As the silting of earthy matter into their pores would soon suffocate them, we find in standing pools the most flourishing specimens attached to the under side of stones or water-logged timbers, which shield them from the intrusion of the heavier silicious particles; whilst in clear lakes and rapidly flowing streams they plant themselves boldly upon the upper surface of stones in the full sunlight.

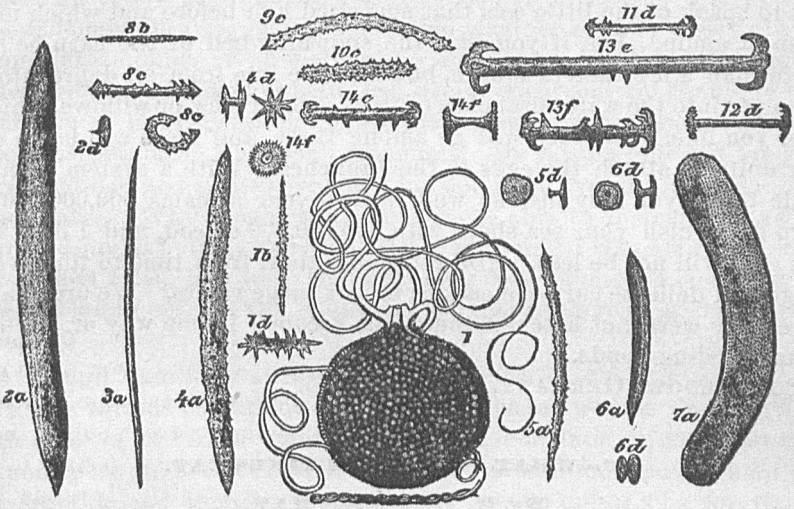
A further hint as to the bodies of water which favor their growth may be found in the fact that three species, one of them the most peculiar of American forms, were found in a stream a child could step over; five were gathered at one time in the submerged cellar of a burnt mill; while the timber-work of the dams upon some of our largest rivers has furnished rich collections; so that there is scarcely a situation where water stands or runs, excepting upon the muddy bottoms of shallow streams or mill-ponds, where sponges may not be hopefully sought for and frequently discovered.

The best season for collecting sponges varies with the different species, but may be generally stated to be from the last of July to the middle or latter part of November, when the spicules and statospheres are likely to be fully matured. They may be preserved in dilute alcohol or dried by a few days' exposure to the air; in which condition (as the personal "application" of the foregoing sermon), the writer would be very happy to receive specimens from all parts of this and other countries. If packed in light boxes, strong enough to prevent crushing, the

postage by mail (4th class) will be but one cent per ounce, which the writer will gladly repay, with any other reasonable expenses. He will acknowledge their receipt, giving the names of known species and full credit to the collectors of all that are novel or interesting. Every gathering should be marked with its habitat, the date of collection, and the name and address of the sender.

A principal motive for the preparation of this circular at the present time is found in the desirability of securing as full a representation as may be, of the American forms at least, in a monograph now in course of preparation; but contributions will always be very acceptable.

228 SOUTH THIRD STREET, PHILADELPHIA, PA., *June*, 1883.



EXPLANATION OF CUT.

The accompanying figures are drawn from nature by the aid of the camera lucida and represent the relative sizes and shapes of *like parts* of several sponges. The statosphere is magnified about 35 times, the spicules of the skeleton, marked *a*, 150 times, all other figures 225 times.

1. Carterius tenosperma—Section of statosphere. (In the other genera these are without tendrils.) *b*, dermal or flesh spicule; *d*, birotulate spicule of outer coat of the statosphere.
2. Parmula Batesii—*a*, skeleton spicule; *d*, parmuliform spicule of statosphere.
3. Spongilla montana—*a*, skeleton spicule.
4. Meyenia fluviatilis—*a*, skeleton spicule; *d*, birotulate statosphere spicule and disk of rotule.
5. Tubella Pennsylvanica—*a*, skeleton spicule; *d*, inequibirotulate spicule of statosphere and disk.
6. Meyenia Leidii—*a*, skeleton spicule; *d*, birotulate statosphere spicule and disk.
7. Uruguaya corallioides—*a*, skeleton spicule.
8. Spongilla lacustroides—*b*, dermal spicule; *c*, statosphere spicule.
9. Spongilla fragilis, var. minuta—*c*, statosphere spicule.
10. Spongilla fragilis, var. calumeti—*c*, statosphere spicule.
11. Meyenia crateriforma—*d*, birotulate statosphere spicule.
12. Meyenia Everetti—*d*, birotulate statosphere spicule.
13. Heteromeyenia argyrosperma—*e*, *long*; *f*, *short*, birotulate statosphere spicule.
14. Heteromeyenia Ryderi—*e*, long, *f* short; birotulate statosphere spicule.

66.—MANAGEMENT OF SPAWNING CARP.

By HERR VON BEHR.

[From a letter to Prof. S. F. Baird.]

I have just been reading the letter of Edward Stabler in the 1883 Bulletin, page 127. *Please tell it as loud as you can that carp must be kept by themselves if you want them to spawn.* Mr. Stabler tells that he intends to clear out turtles, eels, snakes, &c., and well he may! But turtles will march over the ground again, and again fall into his lake; not to speak of the little eels that surprised him before and which may peep in again. Let, if you like, the spawning-bed of the carp be not more than a few meters square, but let it be free from all depredators. Also put into the water branches of trees, evergreens, or willows, whichever you like. The carp will go among these, and there will be an opportunity to attach the eggs to the branches. With a system of such little tanks you may just as well furnish your streams 500,000,000 of carp as furnish your sea-shore with 500,000,000 of cod, and I dare say the gain will not be less. You remember that, from time to time, very large and delicate carp are caught in our large rivers. We are nearly sure they were not hatched there, but escaped in one way or another from breeding-ponds.

SCHMOLDOW, GERMANY, *October* 8, 1883.

67.—WHAT FROGS SOMETIMES EAT.

By R. H. DOWNMAN.

[From a letter to Charles W. Smiley.]

Mr. C. M. White informed me this morning that one of the bull-frogs shot by him at his pond had in his capacious maw a good-sized frog which he had swallowed *sine grano salis*, and he thinks that frogs destroy many young fish. If they feed upon each other, as I know they do, I see no reason why they should not feed upon fish.

WARRENTON, VA., *October* 13, 1883.

68.—SHAD, HERRING, ETC., EXCLUDED FROM THE RAPPAHANNOCK RIVER BY DAMS.

By R. H. DOWNMAN.

[From a letter to Charles W. Smiley.]

Fifty years ago, before the Rappahannock River was obstructed by the erection of mill-dams, shad were taken in large quantities at Beverly's Ford, and white perch and herring as high up as the Fauquier Springs.

WARRENTON, VA., *October* 13, 1883.

69.—CAN WE DO ANYTHING TO DECREASE, PRESERVE, OR INCREASE THE NUMBER OF OUR USEFUL MARINE ANIMALS?*

By KARL MÖBIUS.

The fishermen of the Prussian coast have for a long time complained of the decrease of the flounders (*Pleuronectes flesus*). It is also alleged that, on the Baltic coast of Schleswig-Holstein, the flat fish, especially the golden flounders (*Pleuronectes platessa*), are on the decrease. Accoding to the statement of a Kiel eel-smoker, the net-fishery for summer eels (with yellow belly) is said not to produce as much as in former times. These complaints suggest the question whether man is really able to change the number of animals in the sea. On land man has exterminated wild animals and substituted useful ones; and by changing the character of the vegetation he has driven away from various localities many insects, birds, and small mammals. By raising different kinds of good food-fish he has also extended his dominion over the inhabitants of fresh water. Why should not man also be able to increase the useful marine animals? This question lies so near that I was not in the least astonished when, last year, the directors of our Fishery Association requested me to make it the subject of a paper to be read at the general meeting.

Although I am fully aware of the fact that we are far less acquainted with the various conditions of life of the useful marine animals than with those of the fresh-water fish and the land animals, and that consequently we are not yet prepared to make as well-founded rules for the preservation and increase of the useful marine animals as for the increase of fresh-water fish, I considered it my duty to comply with the request of our directors, with the view of making more generally known the great truth that the preservation and increase of marine animals is subject to the same general laws as that of the land animals and fresh-water fish; and of stimulating our fishermen to carry on their business in such a manner as not to decrease, to their own loss, the number of useful marine animals.

In every territory—both land and water—where animals are able to live, an average number of animals is developed per season, or per year, which is duly proportioned to the conditions of food and propagation within that territory. The entire inhabitable portion of our globe is therefore fully occupied by plants and animals. The truth of these assertions can easily be proved by examples from agriculture. Every farmer knows, from his own experience, how many grains of seed will

* *Können wir dazu beitragen, den Bestand unserer nutzbaren Seetiere zu vermindern, zu erhalten, oder zu vermehren?" von Karl Möbius, Rendsburg*, 1883. Paper read at the general meeting of the Schleswig-Holstein Fishery Association, at Neumünster, March 1, 1883. Translated from the German by HERMAN JACOBSON.

be fully matured in his fields. He knows that the quantity of field and garden produce is increased by manure, which supplies the vegetables with the necessary food. He knows exactly how many heads of cattle his land can feed. It is very disagreeable to him that he has to wage a constant war against weeds, which threaten to diminish the room and food needed for his cultivated plants, and against hurtful animals which injure his domestic animals. It can also be shown by examples from the fresh-water fisheries that the quantity of fish raised is dependent on the quantity of food found within a certain territory.

The estate of Hagen in the Probstei [a district of Holstein] has a carp-pond, measuring upwards of 80 hectares, which is drained for each alternate period of three years, during which time oats and clover are cultivated in it. At the end of three years the water is again let into the pond, and 30,000 one-year old carp are placed in it, which after three years generally yield 20,000 kilograms of food-fish. In order to obtain still better results more than 30,000 young carp were once placed in the pond. After three years had elapsed the number of fish was greater than heretofore, but in all they did not weigh more than 20,000 kilograms. The quantity of carp-food, therefore, which this pond produced in three years had produced the maximum quantity of carp of which it was capable.

As the food of carp consists of tender vegetable matter, of insects, and other small aquatic animals, ponds with a heavy bottom developing rich vegetation and animal life are particularly suitable for carp-culture. In carp-ponds where fish are to be developed for the market in as short a time as possible, there should always be some pike. These fish of prey, by devouring the young of other less valuable fish and spawning carp, remove from the pond useless destroyers of good carp-food, and thus, by their voracity, further the development of the carp.

A carp-pond is, therefore, not merely a body of water inhabited by carp, but a community of different plants and animals, which in that water find all the conditions of their well-being, and each kind of which is represented by the greatest number of individuals which, under these conditions, can be developed, for in all kinds of animals the number of individuals in each period of propagation which reach full maturity is smaller than the total of seed or eggs produced.

Like the carp-pond, every coast-water of our Baltic and North Sea coasts is a community of living beings, which in various ways are mutually dependent upon each other, and which, combined, exhibit the maximum quantity of life which can be developed under the given circumstances or conditions. Among these conditions are: the temperature, saltness, and movements of the water, the depth and character of the bottom, the degree of fecundity of the various animals and plants, and the migrations of some kinds of animals.

That the combined effect of all these causes in the bays of our Baltic coasts produces in the course of each year the full number of animals

which they are capable of producing will appear doubtful to those who have seen in the Baltic, besides fish, crabs, and shell-fish, only worms, snails, starfish, and medusæ.

The enormous number of small animals and plants which, at certain times, float about in the water, and the many worms, crustaceans, and shell-fish which densely throng every muddy bottom, can only be observed by applying the scientists' implements of investigation—purse-nets with fine meshes, floating-nets, drag-nets, sieves, and magnifying-glasses. Even the sharp eyes of the fishermen cannot see most of those small animals which form the principal food of herring, sprat, mackerel, and flounders.

It is evident that the fisheries became a disturbing element in the natural co-operation of all the members of the communities of living beings in our seas.

From May, 1879, till the end of February, 1880, the fishermen of Eckernförde, in Schleswig, caught upwards of 1,407,000 golden flounders (*Pleuronectes platessa*), according to reports made from Eckernförde to the Kiel Commission for the scientific investigation of the German seas.

We do not know whether this number of fish, if left undisturbed, would have increased still further, or how many eggs they might have laid, if they had not been caught. It is certain, however, that during those ten months the number of golden flounders has been diminished more by the Eckernförde fishermen than could have been done in the same time by seals and other enemies of these fish or by other causes. And what were the necessary consequences of this decrease?

(1.) For those flounders which had escaped the fishermen's nets, the removal of so many of their kind had certainly this advantage, that the survivors had more food at their disposal; and as, moreover, those fish which had escaped were, probably, mostly small fish, they would have a still better chance to have plenty to eat, and thus grow faster, than if the additional 1,400,000 flounders would have had to share the food with them. For, large as is the quantity of shell-fish and worms at the bottom of the sea, it has, after all, its limits; and it certainly will not increase, if the number and the demands of these voracious fish increase.

(2.) As the 1,400,000 flounders were caught before they had, once more, engaged in the work of propagation, their removal implied the removal of a considerable number of young flounders.

On the 26th and 27th February, 1883, I bought in the Kiel fish market five live female flounders, measuring 27 to 36 centimeters in length and weighing 200 to 450 grams. The ovaries of the largest one of these fish weighed 110 grams and only contained immature eggs. By counting the eggs of two small, but carefully weighed, portions of these ovaries, it was found that there were 2,558 to one gram; according to which there would be in the two ovaries 281,380 eggs. As with the other four the eggs were already flowing from the genital openings, and the ovaries contained large mature and small immature eggs, the

weighing, counting, and calculating did not give as reliable a result as was the case with the largest fish. For these four I got the following number of eggs: 48,000, 80,000, 108,000, and 116,000; and these figures are certainly below the actual number of eggs. All the five flounders together contained 633,380 eggs, which would make the average number of eggs per spawner 126,676.

As according to the observations of the fishermen there are always two to three female flounders to one male, it may be supposed that of the 1,400,000 caught in the Eckenförde waters during the years 1879 and 1880, at least 900,000 were spawners. Giving to each of these an average of only 120,000 eggs, the number of flounder eggs withdrawn from these waters would be 900,000 times 120,000 = 108,000 millions, or more than 100 milliards, whereby doubtless the number of young flounders in the summer of 1880 had been considerably decreased. For it would be a great mistake to suppose that the withdrawal of so large a number of eggs would do no harm, because the surviving flounders would lay a sufficiently large number of eggs.

Similar opinions relative to the oyster have induced the oyster fishers on the coast of France and England to entirely ruin their oyster beds. When they had learned that a grown oyster produces 1 to 2 millions young oysters, they thought that a few mother oysters would suffice to rapidly populate again an oyster bed where fishing had been going on. They, therefore, scraped the beds so long that the work ceased to be profitable. Of the young oysters which develop in the so-called "beard," between the mantle and the gill-plates of the mother oyster, only a comparatively small number reach suitable places on the bottom of the sea, where they can develop to oysters which are fit to be brought into the market. Many of them get into the sand and heavy mud, in which they are smothered, while others, which have found a suitable body to which to adhere, are eaten by star-fish and crabs before their shell is thick enough to ward off these enemies.

The eggs of the flounders are also exposed to many dangers before they develop into mature fish. When, coming from the ovaries, they reach the water, the spermatozoa of the milters must enter them, in order that they may develop. The female does not protect her eggs, but leaves them to their fate. It is likewise certain that many of the impregnated eggs are devoured by other animals before the young fish slip out; and even later many of the young fish become the prey of other fish and aquatic birds, at least as long as they float about near the surface and live in shallow waters near the coast.

Thus, even under the natural conditions of life, only a small portion of the numberless flounder eggs produced each spawning season ever reach sexual maturity. A large production of eggs in any species of animals is, therefore, by no means an indication that large numbers of these animals will be raised. A female intestinal worm (*Ascaris lumbricoides*) produces about 60 million eggs, and a female tape-worm

(*Taenia salium*) 40 millions. Most of these millions of eggs are destroyed because numerous and regularly recurring difficulties prevent their development. It is highly probable that this enormous production of eggs has been brought about by these very difficulties. Only the most fertile kinds bequeathed their qualities from one generation to the other in the struggle with the numerous destructive influences, because they furnished a larger number of combatants than the less fertile kinds, which therefore finally died out.

Where would all the flounders find food and room, if *all* the eggs of the mature spawners were destined to become fish? It is only by the circumstance that the mature females lay so many eggs that the full amount of flounders allowed by the quantity of food obtained, and the life in common of all the members of their community, can be maintained. How can we demand that this amount, exposed to so many natural enemies, should not be decreased by our destroying milliards of eggs before they have been laid?

We can do this without diminishing the amount if we remove the natural causes by which eggs and young animals are destroyed. This is successfully done in artificial oyster-culture in Holland and France, where the oyster spawn is, in suitable places, made to adhere to bricks, and the young oysters are protected in boxes and artificial basins against enemies and other hurtful influences, and allowed to grow to maturity in places where there is plenty of food.

If we desire to obtain permanently from our coast waters more useful salt-water fish than can be developed under the natural conditions of life, we must protect their eggs and their young according to the same rules which are followed in the artificial culture of oysters and fresh-water fish. We might possibly construct basins for flounders in suitable places on the coast, where artificially-impregnated eggs, protected from enemies, would develop in much larger quantities than in the open sea. Suitable food for the young fish might be introduced by frequently renewing the water from the sea before the young fish are allowed to go into it.

If it is possible to start such flounder hatcheries, or similar ones, for stocking the waters on our Baltic coast with flounders, their construction, support, and superintendence would cost so much that before they can be constructed an attempt will have to be made to carry on the flounder fisheries in such a manner that they will permanently yield the maximum quantity of fish which they can yield under the existing natural conditions; and this they can only do permanently when no small fish are caught at all, and, during a certain protected season, no full-grown ones. The fishermen themselves must learn to know this, and for their own advantage act accordingly.

I believe that these explanations have made it sufficiently plain that the number of animals within a given territory is not dependent on accidents, but is determined by the co-operation, according to fixed

laws, of existing causes; and in treating of our relations to some other useful marine animals, not mentioned so far, I shall be able to be brief.

First, as to the herring: formerly it was thought that at certain periods the herring in their migrations from their home in the northern seas, also visited our coasts, and that all those which escaped fish of prey and the fishermen again returned to their home. Now, we know for certain, that every part of the Baltic which is distinguished from other parts of the Baltic by its temperature, its vegetation, and its fauna, has its own peculiar kind of herrings. Thus the herrings of the bays of Kiel and Eckernförde, as well as those which ascend the Schlei, belong to one and the same kind, which fact leads us to the conclusion that they are born and developed within the limits of this territory, and that, therefore, it is a matter of considerable importance what relations we hold to the conditions of life in this their home.

The herring which, during the winter months, find good food in the bays of Kiel and Eckernförde, migrate, when their sexual organs approach maturity, to shallow coast waters having less saltness than the Baltic, especially to the upper portions of the Schlei. As they spawn in these shallow brackish waters, and as the young herring are hatched there, it is highly important to let at least as many full-grown and sexually mature herrings get there as is necessary to keep the stock of herrings in our coast waters at its average height.

According to the reports made by the Schleswig fishermen to the Kiel commission for the investigation of the German seas, the herring fisheries in the inner portions of the Schlei have not declined during the period 1878–1882, although during that period more nets than formerly have been placed outside the mouth of the Schlei. Even the building of a railroad bridge across the Schlei has not disturbed the herring in their ascent. But if, by an increase of the number of stationary nets outside the mouth of the Schlei, and of the nets and herring-fences in the narrow parts of the Schlei, the herring fisheries in the entire coast territory of Schleswig-Holstein should be caused to permanently decline, the limits of the allowable fisheries would have been exceeded. Want of food cannot cause a decrease of the average number of herring or other useful marine animals in our coast-waters or in the sea, because the plants and small animals which form the principal articles of fish-food are every year produced anew, and therefore remain in the sea. If, therefore, the quantity of useful marine animals is diminished by the interference of man, we must find the cause of this in the destruction of too large a number of spawn-producing individuals.

In a territory of brackish water so limited and peculiar as the upper Schlei the introduction of a fish of prey may also cause a change in the quantity of fish. In 1875 a number of pike perch were placed in the Schlei; and in 1881 fish of this kind were caught weighing 3 to 4½ kilograms apiece. As this fish chiefly lives on small fish, any considerable increase of its number in the Schlei will not fail to exercise an influ-

ence on the quantity of the young herring which are hatched in that water. Whether the value of the fisheries in the whole of the Schlei would be decreased thereby, is a question which cannot be answered at present.

The sprat, salmon, sea-trout, eel, sturgeon, and lamprey resemble the herring in this, that at different periods of their life they change their location. Just as the Baltic herring, in spring, seek the brackish coast-waters, for the purpose of spawning, thus the salmon, sea-trout, and lampreys ascend the rivers to the neighborhood of their sources for the purpose of depositing their eggs, and, reversing this, the mature eels migrate from fresh waters into the sea in order to spawn there.

The young herring, salmon, sturgeon, and lamprey live on organic matter which is developed in the localities where they are hatched, and after having reached a certain age they go into salt water. Young eels find their first suitable food in the sea, and afterwards develop in fresh water, whilst the salmon, sea-trout, sturgeon, and lampreys transform numberless marine animals into delicious fish-flesh.

The feeding territory of the migratory fish is larger than that of the stationary fish. The migratory fish are, therefore, more of flesh-forming fish than the stationary fish. Their marine pastures and spawning-places located in the sea cannot be changed by man; but it is within our power to change their pastures and spawning-places in fresh and brackish water, or to prevent them from reaching these places. In former times the Windeby Noor, an inlet near Eckernförde, was a good spawning-place for our herrings; but by the construction of a dike they have been deprived of it. We should be careful not to deprive the fish on our coast of any more spawning-places, if we desire that their number shall remain at its average height. For the young eels and sea-trout and the mature salmon, ways should be constructed near mill-dams so they may be able to ascend the streams. The descending salmon, sea-trout, and eels should be protected against turbines and other hurtful contrivances, if we desire that, both in fresh and salt water, all that matter which may serve as fish-food shall be transformed into food for man.

Of the shell-fish found in our coast-waters, only oysters and common mussels (*Mytilus edulis*) are eaten in Germany, whilst in France and England the heart-mussel [cockle], and in North America the sand-mussel (*Mya arenaria*) [soft clam] also form articles of food.

For the proper management of our Schleswig oyster-beds we have, by scientific and technical investigations, and by a rational system of renting, gained a safe basis, and they will soon again produce their former quantities of oysters.

With us the number of marketable oysters cannot, by artificial oyster-culture, be raised to such a height as on some parts of the French and Dutch coasts, because we have to contend with vast quantities of ice and heavy floods; but by scattering oyster-shells in parts of the

North Sea near our coasts, where a firm bottom is found, the area of colonies of young oysters will gradually be enlarged.

The attempt to plant oysters on the east coast of Schleswig is still in progress. Of the American oysters which had been planted a great many were still alive in September, 1882, when I had occasion to examine the oyster-beds; but no young oysters produced by them could be found. For continuing this experiment I have recommended to obtain American oysters from the outermost limits of the territory where they live; *i. e.*, from beds where they have been accustomed to the lowest degree of saltness and the coldest temperature which they are able to stand, because the water of the Baltic is less salty and, on the whole, colder than that of the North Sea.

Within the entire German coast territory of the Western Baltic, from the Little Belt to the west coast of the island of Rügen, the common mussel ought to be used as an article of food a great deal more than has been done hitherto. Only in the bays of Kiel and Apenrade mussel culture has been carried on for some time, by driving trees and piles of beech-wood in suitable places into the firm bottom at such a depth below the surface that they remain free of ice. After three or four years the mussels are harvested. Aided by the commission for the scientific investigation of the German seas fishermen have driven piles for mussel-culture in the bays of Kjelstrup and Gjenner; and in the Flensburg Fiord an enterprising fish-dealer has succeeded in changing tolerably large mussels, which originally had a muddy flavor, in some months, into a good, marketable article of food, by placing them in inclosed pens within the water. It is to be hoped that these attempts will be imitated by many fishermen. When large quantities of mussels, of an improved kind, are raised in our bays, a profitable market for them will not be wanting, especially as the mussel is gradually becoming a favorite article of food in the interior of the country.

My object in these remarks has principally been to point out the important fact that the quantity of useful marine animals within a certain given territory is dependent on the co-operation of many different causes, the principal one being the quantity of food found within that territory and the quantity of spawn produced every year. The changes of the temperature of the atmosphere and the sea-water, which are frequent with us, will certainly not remain without influence on the entire vegetable and animal life of our coast-waters, and will either increase or diminish the quantity of food of the marine animals as well as their fecundity. Years of great or limited fecundity are always followed by years of an average increase. Only on these last-mentioned years the fishermen should base their calculations and they will be absolutely safe. They may safely regulate the quantity of implements needed on these calculations, unless they desire more of nature than she can give them according to her immovable laws.

Vol. III, No. 26. Washington, D. C. Oct. 29, 1883.

70.—PRODUCTION OF YOUNG FRY OF THE CARP.*

By CARL NICKLAS.

For centuries it has been customary, in pond-culture, to place more spawners than milters in the spawning-ponds; and it has been recognized as the most profitable plan to make the proportion two males to three females.

In opposition to this plan, the arch-ducal farmer, Mr. Gasch, at Kaniow, published a phamplet, on the occasion of the Berlin Fishery Exhibition of 1880 in which he recommends the proportion of one spawner to two milters for spawning-ponds. He says: "According to Dub's method, I invariably make the proportion of the stock in each spawning-pond one spawner to two milters, which is sufficient to produce all the young fry need for the stocking of our own and Prince Pless's ponds, which we rent; in all, 60,000 young fish. To place more spawners in a pond is not only unnecessary, but also injurious, because very easily too much fry is produced, which would not find sufficient food in the pond."

Weighing the pros and cons in this question from a purely theoretical point of view I arrive at the only conclusion which, in my firm opinion, can be in any way defended, that it certainly, is more rational to make the number of milters greater than that of the spawners. This does not, however, force me to the further conclusion that the reason why so many pond-farms cannot raise the necessary quantity of small fry is found in the circumstance that more spawners have been placed in the ponds than milters, much less in the fact that several sets of fish are placed in the spawning-ponds in nearly all cases. In the many pond-farms which I have had occasion to visit, I have not once come across a case where I found a pond, be it ever so small, stocked with only *one* set of fish. In my own practice, although retaining the old method, and placing, in all cases, several sets of fish, each having more spawners than milters, in one spawning-pond, I have always obtained an ample supply of young fish.

In stocking a spawning-pond with several sets of fish, the proportion between the spawners and milters cannot exercise any great influence. In this case the natural desire of the carp finds ample room for play, no matter whether there is a tendency for one male to associate with several females or for one female to associate with several males. If several sets are placed in one pond, for example, nine females and six males,

* *Erzeugung von Karpfenbrut.*—In "*Deutsche Fischerei-Zeitung,*" Vol. VI, Nos. 1 and 2, Stettin, January 2 and 9, 1883. Translated from the German by HERMAN JACOBSON.

either two sets will form, each composed of three milters and two spawners, or *three* sets, each composed of two milters and one spawner, which are sufficient in either case to furnish more young fish than are needed even for a very large pond-farm, even if the eggs of the remaining five or six spawners should not become impregnated. The reason why there are frequently not enough young fish is, in my opinion, to be found in the circumstance that the spawning-ponds are too large or unsuitable in other respects; and if only *one* set of fish were placed in such ponds, no young fry, or at beast but a very small quantity, would be obtained.

It must be said in favor of the old method (of composing each set of fish for the spawning-ponds of more spawners than milters), which at present is followed in most pond-farms, that two spawners, supposing them to be entirely equal in every respect, will of course produce twice as many eggs as one; but, on the other hand, though there is nothing to disprove such an assertion, it is very doubtful whether both spawners have become impregnated by one milter.

As no signs of either bigamy or polygamy have as yet been observed among fish, especially among carp, whilst it has often been noticed that several males will engage in mortal combat over one and the same female, I am rather inclined to think that if two females were associated with one male, one of the former would find herself neglected. Moreover, it can hardly be supposed that when the fish are at liberty in a large basin of water, the milt of one male is sufficient to impregnate the eggs of several females, and that the male husbands his milt as much as a pisciculturist, who thereby succeeds in making the milt of one male suffice for the impregnation of the eggs of several females. Experience has taught men to abandon the wet method of impregnation for the dry method. According to this experience, however, it would seem most profitable to have the set composed of more males than females, if a large quantity of fry is aimed at.

On the other hand, I can positively see no reason why one set of fish in a pond should furnish more young fry than several sets, as the very laws of nature seem to forbid it. It is undeniable, however, and well known from olden times, that small ponds are the best for producing young fry. The reason is this, that they are generally flat, and do not contain much vegetation, that consequently their water is much warmer than that of large and deep ponds, and that there is less chance of eggs and fry being injured, especially by the various enemies of fish. There is this additional advantage, that they are easier to superintend, and that the eggs and fry can be better protected from dangers. But no sound reason can be advanced in proof of the assertion that one set of fish in a pond will produce more young fry than several sets.

The following may serve as a contribution towards the practical solution of the problem. A friend of mine, who had so far only engaged in raising salmonoids, wrote me under date of August 9, 1881:

"My young carp have almost rendered me desperate. On the 1st June,

I finished my two spawning ponds, and stocked them immediately. In one of them I placed one spawner and two milters (mirror carp, weighing 7 pounds each). The first pond is about 46 meters long and 7 meters broad (322 square meters = about 3 ares, or $\frac{3}{100}$ hectares). The depth of water was 40 centimeters at the place where it flowed in the pond, and 90 centimeters where it flowed out. The second pond is just as large, but is stocked with 64 female carp and 36 milters, each weighing 1 pound (this should probably be 1 kilogram). The carp were placed in the pond on the 4th of June; on the 5th they spawned, and on the 11th the young carp left the eggs. One of the female fish has produced so many young fish that I hardly know where to place them; and the same is the case in the second pond. The mirror carp resemble the specimen sent with this letter (on an average 4 centimeters long). I have already taken out 8,000 and put them in other ponds; and still the pond is so full that one fish is almost on another; there are probably 300,000 fish, if not more, left in the pond. They seem lively and in good condition, but I fear that many will die in consequence of overcrowding. These young carp, when placed in a pond 1 meter broad and 6 meters long (6 square meters), and 10 centimeters deep, died at the rate of 500 in a day, although I placed fresh water in the pond twice every day, once in the morning and once in the evening. It is also noticed that in the two large ponds (each having an area of 322 square meters) the carp invariable only stay in the places where the water flows into the ponds; they crowd towards the water at its influx in such enormous numbers that on Monday I caught 2,234 at a single dip of the catcher. Along the edges of the pond the fish gather in very large crowds. I feed them with boiled fish-roe, which I scatter in the water, near the edges, and which the fish devour so eagerly that not a single fish egg is left. Have you ever heard of anything like it? In the second pond there are perhaps several millions of fish, but they are not as large, only about half the size of those in the first pond."

These statements regarding two ponds stocked in different ways show clearly that vast numbers of young fry can be raised in small flat ponds where no dangers threaten the eggs and young fish, and where it is possible to keep a strict surveillance; and that more young fry are obtained from one set of spawners and milters than from another.

The result of the experiment made in the first pond shows more especially that the method to compose a set of more milters than spawners, guarantees the impregnation of *all* the eggs. To judge from the large number of fish hatched in the above-mentioned ponds, it seems that all the eggs of one spawner had been impregnated, and that young fish had been hatched from them.

It may of course be questioned whether the impregnation was caused by one or both milters. It is, however, doubtful whether, with a proportion of one milter to two spawners, all the eggs of each one of the spawners would be impregnated by that one milter.

Instead of simply placing one set of two milters and one spawner in one pond, I would prefer to place two sets, even in very small ponds, as accidents may occur, and it may frequently happen that a spawner cannot discharge her eggs, or that they are not in a healthy condition. And in that case persons having only one pond, containing a single spawner, would not obtain any young fish at all; there is, of course, less chance that two spawners will both meet with an accident, and, on the whole, it will hardly ever hurt to have too many young fish, as there are many ways of diminishing their number.

The result of the experiment made in the second pond, which, according to the former practice, contained more spawners than milters, cannot be adduced in favor either of a preponderance of spawners or a preponderance of milters, as, owing to their small weight (at most 1 kilogram apiece), a large portion of them were not fully matured for spawning, and as consequently it was impossible to ascertain how many females and how many males engaged in producing young fish. But even if this were possible, there would absolutely be no means of ascertaining how many young fish would fall to the share of one set.

Although it is hardly possible that any one but my friend referred to above would conceive the idea of stocking a pond of 322 square meters with 100 spawning fish, the result of the experiment made in the second pond proves this, at least, that it is not necessary only to limit the number of fish in a pond to one set in order to obtained a large quantity of small fry, but that the more spawning fish are placed in a pond the more young fish will be obtained from such a pond.

The experience of Mr. Gasch (the average size of his spawning ponds is 34 ares) and the results of the experiments made in the first pond prove that even in a very diminutive pond enough eggs can be produced to supply a large pond-farm, and that a sufficient quantity of young fish can be hatched from them.

Any pisciculturist can convince himself, by carefully observing the spawning-ponds during the spawing and hatching season, that there is never any lack of eggs and young fish in large ponds. But the dangers to which they are exposed, and against which there is hardly any protection, cause the destruction of by far the larger portion of the eggs and young fish.

Although I think that there are very plausible reasons for composing the set of more milters than spawners, I cannot, so far at least, absolutely reject the opposite plan of our older pond-culturists, which has in many places been retained to the present time. I first want to know what reasons influenced pisciculturists in olden time to follow this method as it seems hardly probable that their following it had been purely accidental. Unfortunately, no light is thrown on this subject either by ancient or modern writers. In *Horak's "Teichwirthschaft"* (Pond-culture) we find in the chapter entitled "*Streichteiche*" (Spawning-ponds) only one reason given why one should associate only three, and not four,

spawners with two milters, and this is that people allege to have observed that if four spawners are associated with two milters, the female fish preponderate too much among the young fry, and that buyers had made complaint at being served with too many females. It is difficult to refrain from a smile when reading of such strange notions. I cannot but state here as my opinion—and probably many of my readers will share my view—that if in the instance referred to the first pond had been stocked in the proportion of two spawners to one milter, the roe of one of the female fish would certainly have been impregnated, and as many young fish would have been produced as in the other case, and that, moreover, we could not exclude the possibility of the one milter also impregnating the eggs of the second spawner, thus producing twice the quantity of young fish. Aside from the fact that two spawners, equal in every respect, will produce more eggs than one, I can only imagine one other reason which could have led our old pond-culturists to adopt their favorite method, viz, that the male carp desires to have his choice of females, and that if he finds none with which he chooses to mate, he will remain aloof. Could our old pond-culturists have been guided by considerations like these? I shall not venture to answer this question.

From all that has been said, it will appear evident that, even if strongly convincing reasons speak in favor of more milters than spawners in each set, reasons which even decide me to declare in favor of this method, there may possibly be some very cogent reasons for the other method so that this part of the problem cannot, without the most exhaustive and thorough experiments, be considered as definitely settled. This is certain, however, as it has been held from time immemorial that small flat ponds are the most profitable for spawning ponds. But, unfortunately, such ponds cannot be found everywhere; and even when there are such they are often so located that they cannot be stocked with spawning fish without great risk of their being stolen. The small pounds are generally in villages or quite near to them. Other ponds there are, which, although small enough, cannot be used as spawning ponds on account of their being too deep or having very steep banks, or because their water is too cold, or the forests surrounding them too dense, &c. I can testify from my own experience that in a large pond-farm which I had to superintend a number of years ago, I had, comparatively speaking, a very large number of small ponds, which, on account of one or the other of the above-mentioned defects, could not be used as spawning ponds, so that I had to use larger ponds. The same experience has been had upon another large pond-farm with which I am well acquainted.

Under these circumstances, it would be profitable, and therefore advisable—considering the greater safety offered by small, flat ponds—to specially construct such ponds in the most favorable locations which can be secured. But as it is not only the object of the pond-culturist to obtain a large number of young fish (at any rate as many as are

needed in his establishment), but also to obtain as large and strong fish as possible, not much is gained for the growing fish by small spawning ponds; for, unless one desires to obtain nothing but miserably small fish, as was the case in the two ponds referred to above, the young fry have to be taken out of the small ponds two to three weeks after they have been hatched and transferred to larger ponds, in which case one can count on only 1,500 fish per hectare. For in spite of the largest possible number of small fish in spring, there would be few, if any, young fish in autumn; for the smaller the fish the tenderer they are, especially with regard to cold winter weather.

It will therefore always remain impossible to obtain annually, in very small ponds, young carp which are strong and healthy in any very considerable numbers.

71.—PRICES OF CARP, TENCH, AND GOLDORFE IN GERMANY.

By F. ZENK.

The proprietor of the Seewiese Fishery, Mr. F. Zenk, of Wurzburg, Germany, has forwarded his price-list to the United States Fish Commission, several items of which, when translated into American money, are as follows:

Mirror carp per hundred	$4 84
Leather carp per hundred	7 26
Crucian carp per hundred	2 42
Golden carp per hundred	9 68
Tench per hundred	2 90
Golden tench per hundred	9 68
Goldorfe (Golden ide) per hundred	12 10

72.—VARIETIES OF CARP IN SAXONY.

By DR. OSCAR HUNGER.

My father, in Saxony, raised both the scale and naked carp. At least I suppose that what you call naked carp is the same which is there called *schleie*. The latter is an inferior fish, the flesh being too soft and slimy. It grows slower and to a less size than the commoner scale carp, *karpfen*. Besides the common blue-scale carp and the naked carp, *schleie*, there is a third kind of carp, which is not cultivated, but infests ponds in Saxony. It is a degenerate kind of carp, *karausche*, or wild carp. It is quite worthless, not growing over one foot in length, full of bones, ugly in appearance, and hardly fit to be eaten at all. That was 40 years ago, before I left Germany. Perhaps they have since exterminated it.

MADISON, IND., *October* 11, 1883.

73.—DESCRIPTION OF AN EEL-LIKE CREATURE TAKEN IN A NET AT NEW HARBOR, MAINE, IN 1880.*

By S. W. HANNA.

In August, 1880, the following item appeared in the Sea-Side Press:

"S. W. Hanna, of Pemaquid, caught what might be called a young sea-serpent in his nets the other day. It was about 25 feet long and 10 inches in diameter in the largest part, and was shaped like an eel. The head was flat, and the upper part projected out over the mouth, which was small and contained sharp teeth. It was dead when found."

Mr. Allen noticed this newspaper item, and, having written to Mr. Hanna inquiring whether there was any truth in it, was favored with the following reply:

"The report you saw in the Press in regard to a marine monster being caught by me was correct. The fish was about 25 feet in length and from 8 to 10 inches in diameter, with a tail like an eel. The skin was not like a scale-fish, but more like a dog-fish or shark, though a great deal finer in quality. I did not save the fish for the reason that I did not know what I had caught. In fact, I considered it a streak of ill-luck rather than good fortune, having torn my nets very badly and otherwise bothering me in my business. The fish could have been grappled twenty-four hours after, it being in only 4 fathoms of water and it being a small shoal, with deep water all around it. A storm arose later, which made it impossible to do so.

"NEW HARBOR, MAINE, *September* 14, 1880."

Upon receipt of the above, Mr. Allen made a more specific inquiry, as follows:

"I am inclined to think that you caught a rare fish or animal, and I am interested to know more about it. Will you please inform me about its head? Was it like a snake's head? Did the mouth open like a snake's mouth? Were there any gills? Were there any fins near the head? Were there any fins on the back? Will you please draw with a pencil the general shape of the head and also the general shape of the whole body? I do not wish to give you too much trouble, but I think such a description is important.

"HARTFORD, CONN., *September* 17, 1880."

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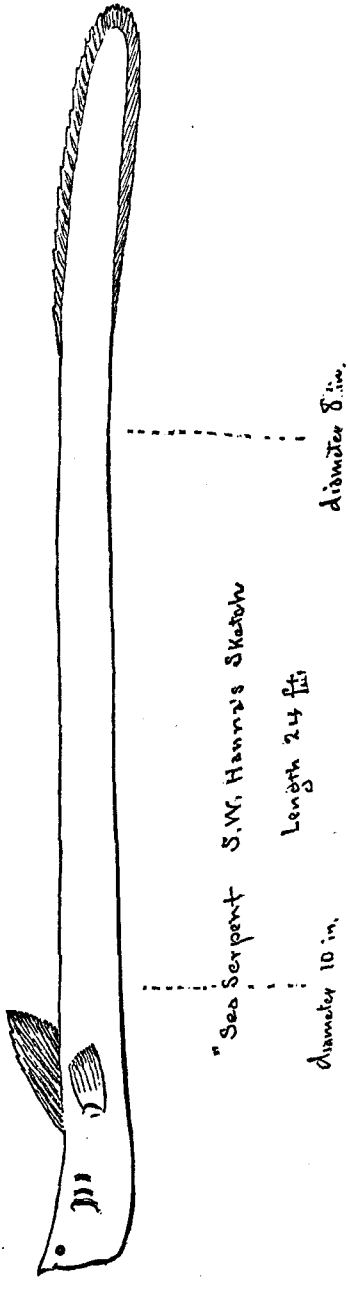
* This account has been compiled from correspondence which passed between Mr. Hanna and J. M. Allen, of Hartford, Conn., and subsequently between Mr. Hanna and Professor Baird. The attention of the latter was called to the matter by Mr. Allen.—C. W. S.

Meanwhile Mr. Allen had written to Professor Baird, who also addressed a series of questions to Mr. Hanna. Under date of September 22 Mr. Hanna replied, giving the same in substance to both Mr. Allen and Professor Baird. The letter to the latter was as follows:



"To the first question I answer, yes. From the head to the tail (exclusive of the head) it did look very much like an eel. Second, the body was round or very near that form. From the head (exclusive of the same) toward the tail was about 12 or 15 feet. The tail was like that of a common eel. Third, the color of its back was of a slate or fish color; belly, grayish-white. Fourth, there were two fins, one on either side, a little abaft the head. They were not stiff-pointed fins like the shark or sword-fish, but more like the side-fins of the cod or sun-fish, only they were in size to correspond with the fish. The top or dorsal fin was like the corresponding fin on the cod. I do not know whether it was stationary or closed, like the top fin of the mackerel and other fish of the same species. To the fifth question I answer, no. All the fins there were on the tail were like those of the eel. Sixth, no. Seventh, there was no projection, elevation, or crest forward of the dorsal fin. The skin was like that of the dog, but very much finer. The head did resemble that of the shark, only more stunted, *i. e.*, it did not lengthen out like the shark's. It looked more like the head of the sucker. The mouth was very small, not any larger than the mouth of a good-sized dog-fish, with fine, briery teeth, and located at the extreme end of the head or nose. The fish was dead when caught. Its mouth was open, and the smallness and location of the same attracted my attention more than any other part of the fish. Inclosed you will find a drawing, as near as I can recollect, of the fish.

"NEW HARBOR, ME., *September* 22, 1880."

On receipt of this letter and the drawing, Professor Baird made the following further inquiry:

"I notice you mark three strokes on the side of the neck as in the shark. Was this the case, or was there a small opening covered by a flap as in ordinary fish? I do not quite understand whether the snout projected beyond the mouth or not, or whether the mouth is in the under part of the head, or in the upper.

"Was there anything in the tail of the fish bearing a resemblance to that of the shark, or did you consider that the resemblance to the eel was more decided?

"You made a distinct fin just back of the head, while the third of the fish towards the tail has a fin running along the back and around on the under side. Does this correspond with your recollection?

"It is a matter of great interest to determine what the fish was. It was apparently something entirely new.

"WASHINGTON, D. C., *September* 24, 1880."

Mr. Hanna then replied as follows:

"The three strokes on the side of the neck in the drawing are correct, corresponding with those of the shark. As regards the mouth, the upper part of the head did project a very little, but not more than from half an inch to an inch. The projection was not so great as in the shark, whose snout projects so that the mouth is cut off half the distance of the head back.

"There was nothing in the tail that had any resemblance to that of the shark. The inference that I drew from your letter is that I caught what the fishermen know as the swingle-tail shark, but such was not the case. I am a fisherman of twenty-five years' experience, and am acquainted with about every species of fish from the capes of Virginia to French Saint Peters [Saint Pierre, off Newfoundland], and I never saw a fish that resembled that one entirely. The shark family is very numerous in the waters of Maine, and there is hardly a day that we do not come in contact with them in some form or other. The swingle-tail is not very plenty here. I have caught one in my day, and have seen a half-dozen. The nurse-fish or liver-shark is another kind. It is a bottom fish, and rarely if ever comes to the surface. There is another member of the shark family that inhabits these waters, but is very scarce, having a shark's head, and the rest of the body like dog-fish.

The tail of this strange fish corresponds in the drawing with my recollection. Being dead, I examined it some ten or fifteen minutes, hesitating whether to tow it to land or let it go. I decided if I landed it I should lose $20 that day in my business, and so could not afford to bother with it. If I had been nearer to Boston or New York, probably I should have saved it.

"NEW HARBOR, ME., *September* 27, 1880."

The closing item of this correspondence was by Professor Baird, who, in thanking Mr. Hanna on September 29, said: "I am puzzled more than ever in regard to the fish. I would gladly have given a larger sum than you mention if I could have had it. Is it possible that any portion—the head, or even any of the bones—could yet be procured, as they would help to identify it? If any portion should be found, I would be glad to have it sent to me." Nothing further was heard from Mr. Hanna on the subject.

74.—DO STRIPED BASS (ROCCUS LINEATUS) FEED ON MENHADEN.

By GIDEON MOSHER.

[From replies to questions in a pamphlet furnished by Joseph Church, and entitled "The menhaden question."]

Striped bass do not feed upon live menhaden, but upon crabs and lobsters. I have been engaged in the bass fishery for 45 years, 30 or 40 years of which I have been in the habit of preparing bass for market. I have prepared tens of thousands of them, but never found any menhaden in them, unless it had been fed to them for bait. My experience extends over the entire range of coast from Mononomy to Beavertail and from Baltimore to Cape Cod. I have found bass most numerous in the Chesapeake Bay, which I attribute to the great quantity of crabs found there. I have always observed that bass fishing was best where lobsters and crabs were most plentiful. My particular locality for taking bass has been at West Island, R. I., and for more than thirty years I never observed or heard of bass feeding on or troubling menhaden, and my business has brought me in contact with many of the most successful menhaden fishermen. I have never heard of but two bass being taken in a purse seine. The bass is a shore and bottom fish.

The absence or the presence of menhaden on the coast does not affect the bass fishery, except in the difference it makes in having or not having fresh bait. You cannot catch bass with stale bait. If the menhaden this year are as far from the coast as they were last year, those taken at Sandy Hook carried to a factory and from there transshipped will be unfit for bait. The only way to do would be to put an experienced man on board the menhaden fishing steamer and ice them alive in the way the bank fishermen treat them. In that way one could make them fit for bait for a month.*

TIVERTON, R. I., *December* 26, 1882.

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* The sworn statement of Mr. Mosher is also indorsed by Charles W. Anthony, Edward C. Smith, Ebenezer Owen, Edward Smith, George M. Crabb, William M. Record, and Thomas Record, all bass fishermen of Newport, R. I.

75.—SOME NOTES ON WHALES.

By JAMES TEMPLE. BROWN.

[From Letters to Prof. S. F. Baird.]

A CALF FINBACK ASHORE.

Several days ago a male finback calf became entangled in the net of a weir in Provincetown Harbor, and not being able to free itself was drowned. The blubber, which is thin and poor, but exceedingly tough and "leathery," filled two and a half ordinary flour barrels.

The baleen, in its natural state firmly attached to the gum and some adhering flesh, is of a light horn color and in a good state of preservation. Both sides of baleen have been put in pickle and Captain Atwood will send it to you if you care for it.

PROVINCETOWN, MASS., *October* 14, 1882.

WHALING ON HORSEBACK.

Shortly after my arrival I was taken with the sperm-whale grampus fever, and finding so many conflicting opinions, both as to the species and the point at which it came ashore, I resolved to investigate the matter.

I called on Capt. N. E. Atwood and learned that you had asked him to procure the skeleton if possible.* Captain Atwood told me that he had made arrangements to visit the outside of the cape yesterday, but owing to the heavy rain and easterly wind he was compelled to postpone the trip. I therefore made inquiry and found that the grampus had been washed ashore below Life Saving Station No. 9, near Parmet River. I interested Mr. Jonathan Cook, proprietor of the Long Point Oil Works, and in him found a ready worker. I proposed that he and I should start out and find "that fish," as he invariably termed it. His brief reply was: "If that fish is ashore, and if Professor Baird wants him, he will have to go to Washington." We mapped out our proposed journey, and found that in going and coming and in traversing the beach, we would be compelled to travel fully 25 miles. The roads were heavy, and we decided upon horses under the saddle as our means

* Captain Atwood had written to Professor Baird October 7, 1882, as follows: "Capt. Jonathan Cook says the blubber was brought to him, and that it was not a sperm whale which came ashore on the back of the cape. It had a dorsal fin, while a sperm whale has only a hump on its back. Besides, he thought the jaw different, but could not tell much about it, as the man who found it cut it up with an ax, and brought the blubber to the oil works in a broken condition. It was very poor and yielded only 12 gallons of oil. I have since seen a man from Truro who said the animal came ashore on the outside of the cape back of South Truro."—C. W. S.

of conveyance. We started this morning at 8.30 and returned at 4 p. m., after a cold and blustering ride in an easterly wind.

At this point I shall digress merely to show the reasonings of a man who is so well acquainted with this coast. Mr. Cook's argument was that if "that fish" came ashore near Parmet Harbor on the "back side" of the cape, the carcass, or that which might be left of it, would certainly work to the "nor'ward," following the bend of the coast, and, judging from the time it had been ashore, and taking into consideration the point from which the wind had been blowing "fresh," he was fully satisfied that we would find it about 3 miles to the north of the point at which it first landed. He then pulled his hat over his eyes, stuck spurs into his horse, and away he went at a lively canter. He kept up this gait until we reached North Truro, a distance of 6 miles, where, much to my relief, we stopped to water the horses. Then away we went again, his sure-footed horse carrying him over sand flats, marshy grounds, through scrub pines and horribly distorted oaks, and I following helplessly.

Having arrived at a blind path leading through a gulch which he called "Long Nook Valley," he said he guessed "we would head him off here," and away we sped across the cape to the sea-shore. We descended a precipitous bank of sand, and felt the spray from the thundering surf which was madly dashing against the beach. My guide, pulling his hat closer over his eyes, plunged the spurs deeper in the flanks of his horse, which, elevating its rear legs and twisting its tail in a most peculiar manner, led me to believe that it premeditated throwing its rider into the surf.

After riding for about one-quarter of a mile to the south, Mr. Cook reined up before the head of the fish, which, true to his predictions, had been washed ashore 3 miles north of its first landing place. I immediately dismounted, and by means of a piece of driftwood cleared away the sand and turned over the mass, which proved to be a portion of the upper jaw or cranium of the cetacean. A fisherman who was picking up driftwood near by told us that no other fish of this kind had come ashore recently. He also said that he had seen the fish; that it was not a finback, nor a black fish, but that he supposed it was a young sperm whale. Upon questioning him he said that he had been living on that coast for sixty years, and had never seen anything like it before.

The cranium was far from perfect, having evidently been severed from the body in a very rough manner, being fractured and hacked at either end. We, however, looked carefully around for other portions of the carcass, marked the spot, and went on down the beach until we arrived at Station No. 9, having found the cranium about 2 miles north of this point, between No. 9 and Highland light. From the captain of Station No. 9, we learned that the remains of the fish had been washed out to sea, during the night, shortly after the blubber had been

removed. I was unwilling to think that the fish was irrevocably lost, and again questioned him. He evidently perceived that I was in doubt, and added that two of his men had seen the fish shortly after it had been killed, and returning to the station described it, and the peculiarity of its head. One of the crew who had not seen the fish, an old whaleman, said he thought it must be a young sperm whale.

I regarded this loss as a serious misfortune, for, from all accounts, it was evidently the same species that was found at North Dennis and Newport, which I believe is *Hyperoödon bidens*.

The captain says that he has not known it to blow so heavy on that coast for ten years, and this may explain its presence on the beach, as well as its sudden disappearance, and it stands to reason, according to the theories of the fishermen, that it should, in an ordinary gale, either be washed upon the beach beyond the surf, or "work to the nor'ward," as did the cranium.

The cetacean evidently ventured too near the coast, and getting caught in the surf was "pitch-poled" (turned end over end) ashore, and becoming blinded and smothered in the sand and "trash" stirred up by the surf, was thrown helplessly upon the beach.

Black Manuel, a resident Portuguese fisherman, saw it struggling in the surf, and, with the assistance of five or six other men, caught hold of the fish while it was "fluking it lively," endeavoring to regain its native element. The men had all they could do to hold the fish until they finally succeeded in killing it with jack-knives. Having stripped off the blubber, Black Manuel detached the lower jaw, which is hopelessly gone. He then "cooked" it with the blubber and cut off some of the "lean" (flesh) to feed to his chickens. To this last operation Mr. Cook attributes the loss of the remains, as he says "when the lean was cut off, holes were made in the bilge (side) of the fish through which the water entered and worked the carcass to pieces." It is possible that some fragmentary remains may be found to the north of the place where the cranium now lies.

Mr. Cook made 12 gallons of oil from the blubber and lower jaw, and I am of the opinion that something definite may be determined in regard to the species by the gravity of the oil The oil of a sperm whale grampus should have the same weight as that of the sperm whale. I am going to Mr. Cook's factory to-morrow to test the oil, and will send you a small bottle of the same.

Not being able to bring the cranium to Provincetown on horseback, and as our horses were pretty well tired out, and feeling satisfied that we could give Captain Atwood more definite information for his plans for to-morrow, we returned home. I immediately called on Captain Atwood, and requested him to have it brought in, if in his opinion it was worth preserving. We will go to-morrow to the point where his informant told him the fish came ashore, which is near Station No. 7, to the north of Highland light, and see the keeper, Captain Fisher, who, ac-

cording to report, has the flukes of this fish. From Station No. 7, Captain Atwood will follow the coast south until he comes to the cranium. This will cover the entire range of the fish and its fragments.

PROVINCETOWN, MASS., *October* 15, 1882.

I went to the oil works to-day to test and obtain a sample of the oil. It was not necessary to test the oil, as it had congealed, and was pure sperm. Mr. Cook, proprietor of the works, pronounced it oil from a "sperm whale calf," while others contended that the animal was the sperm whale grampus. At the factory Mr. Cook took some of the oil, placed it in a woolen cloth, and in the absence of an oil-press, placed the mass in a common iron vise and screwed it up tight. The oil ran freely through the cloth, leaving the pure sperm. The sample I send may have a peculiar odor since it was "cooked" by the steam process.

It may be of interest to add that the bones of the finback whales are steamed in order that they may be employed in the manufacture of a fertilizer. The ear bones are also steamed, but they are the only bones in the whale which are not affected by steam.

PROVINCETOWN, MASS., *October* 16, 1882.

FURTHER EXAMINATION OF THE STRANDED CETACEAN.

Captain Fisher, of Life-saving Station No. 7, Peaked Hill Bar, tells me that the remains of the fish came ashore near his station shortly after they were washed off the beach where they originally stranded south of Station No. 9. He states that they were then in good order. He to-day conducted Captain Atwood and myself to the flukes which we found in an advanced state of decomposition. These I measured. Across the flukes from tip to tip was 47 inches. The depth of the flukes from the last vertebra was 26 inches, and the outside measurement, from the tip to the last vertebra, was 31 inches.

Attached to the caudal fin, or rather forming the central portion of it, is about 10 inches of the vertebral column. This is about all the bone in this part of the animal except, perhaps, some very small bones forming the ramifications to both corners of the flukes. These, however, are composed largely of a cartilaginous substance, while the flukes are exceedingly tough blubber. The flukes were about half a mile north of Station No. 7, 10 miles north of where the fish originally stranded, and about 7 miles from where we found the cranium on the 15th instant.

After Captain Fisher and his men cut off the flukes the rest of the carcass disappeared. They thought it was washed off by the sea, but to ascertain if possibly it was covered by the shifting sands, Captain Fisher will probe the beach with a crowbar. He will also keep a lookout northward, as they might be washed ashore again. He will take care of the flukes, and should you care for the vertebræ he will remove the flesh and forward them.

No one seems to have attached the least value to the fish except the

Portuguese, who was so anxious to obtain the blubber. Hence it was left to the mercies of the waves, and, appearing here and there on the coast, gave rise to different and conflicting reports.

HABITS OF THE SPERM WHALE GRAMPUS.

When the whalemen discover a school of these little, active creatures, from the lookout at the mast-head, believing them to be young sperm whales, they usually lower the boats for a capture. They are very wild and difficult to approach, and are consequently very rarely taken. When struck with a harpoon they suddenly "turn flukes" and descend to the depths below with astonishing celerity, taking all the line allotted to one boat, usually 300 fathoms. In this way fish, harpoon, and line are all lost. As soon as the whalemen perceive that the school is not composed of sperm whales they draw off, and the sportive fish pursues the even tenor of its way. Even when taken, as they are occasionally, they yield very little oil, on account of their smallness.

The whalemen distinguish the sperm whale grampus or "square-headed grampus," as they term it, from the young of *Physeter macrocephalus* by the spout. The former blows oftener at a rising, and the time of respiration is much shorter or "quicker."

The captains of these life-saving stations are generally just the men to know all about such rare specimens being cast upon the coast. The crews are often composed of fishermen and whalemen. Capt. Isaac J. Fisher, of Station No. 7, was at one time the captain of a whale-ship. As these men patrol the beach they have time and facilities for rendering you assistance.

PROVINCETOWN, MASS., *October* 18, 1882.

PLANS FOR OBTAINING HEAD AND SKELETON OF A SPERM WHALE.

The heads, including the case, junk, and white-horse, of all whales under 25 or 30 barrels, can, by the improved windlass power, be raised from the water and hoisted on deck, where they are dissected. The lower jaw-bone is wrenched from its socket separately and also landed on the deck. The heads of the larger whales are usually dissected in the water. It would, therefore, be easy, after saving the junk and the contents of the case, to preserve the osseous formation; but I am told it would be a difficult matter to obtain the skeleton of the body. The greatest difficulty seems to me, however, to lie in the fact that none of the fathers or forefathers of the present whalemen ever did such a thing.

I have been told that during July and August sperm whales are occasionally found off Cape Henry, Fortress Monroe, Hatteras, and even Charleston, S. C. Two boat crews could be hired from New Bedford and Provincetown, be taken on board the Fish Hawk, or such other vessel as you might indicate, and make a trip to those waters. Having killed the whale, it would be lashed to the sides of the Fish Hawk, flukes foremost, and towed to the beach at high tide. It could be photographed,

and during the process of dissection photographs could be made of the case, junk, white-horse, &c. Such a cruise could be made in about two weeks, and skeletons enough secured to supply the National Museum and perhaps to stagnate the market. Of course the boats' crews should be selected with the greatest care, and each be commanded by a competent officer.

NANTUCKET, MASS., *October* 21, 1882.

76.—A STRAY COD UP THE HUDSON.

By BARNET PHILLIPS.

[From a letter to Prof. S. F. Baird.]

Under date of yesterday Capt. Jacob LeRoy, of New Hamburg, N. Y., writes:

"The codfish that I caught here was taken in an ice net 100 meshes by 80 meshes square [long and wide] seined in two-thirds [contracted one-third on the cork-line]. This fish laid in the slack of net in a 2¾-sized mesh. It was a female, all spawned out, and weighed 6½ pounds."

TIMES OFFICE,
New York, January 19, 1883.

77.—SUCCESS OF THE COD GILL-NET FISHERY.

[From the Cape Ann Weekly Advertiser, March 2, 1883.]

LARGE CODFISH.—Schooner Blue Jay, Capt. Charles Ellis, of this port, engaged in the Ipswich Bay net cod-fishery, landed a fare of 135 codfish at Rockport last week, which weighed 4,135 pounds, averaging over 30½ pounds each. This was the largest average by the fare that we have recorded.

In 1881, the schooner Morrill Boy, Capt. Russell G. Gill, jr., took on one trip, net-fishing, 319 fish, weighing 9,570 pounds, an average of 30 pounds. Last year, schooner David A. Osier, Capt. Warren Osier, landed a fare of 228 codfish, taken in nets, which weighed 6,500 pounds, an average of 28 pounds each. Two of these fish weighed 98 and 96 pounds respectively.

The net cod-fishing industry in Ipswich Bay continues to be a success, and it is probable that this method will become a permanent one in the shore fishery. It has now been pursued three seasons and has demonstrated its advantages over trawl fishing, in the large saving of expense for bait and the larger size of the fish secured, the smaller fish escaping through the meshes of the nets.

Vol. III, No. 27. Washington, D. C. Dec. 7, 1883.

78.—EXPERIMENTS IN THE POND CULTURE OF TROUT, SUCKERS, AND CATFISH.

By A. P. GARDNER.

[From letter to Prof. S. F. Baird.]

The first requisite in fish culture in ponds is an absolutely tight dam wherever a dam is needed. My first effort in that respect was perfect as to holding water, but in a few years the muskrats gave me much trouble. I was obliged to take up the plank spiles, dig the trenches deeper, put in sheer-bottom broken glass, and redrive the spiling, besides building a rat-proof stone wall to support the spiling and prevent them from entering under the dam from below; after which, when well graveled, I have had no trouble from muskrats or leakage. In fact, my dam, though rough and cheap, is as impervious to either water or the rats as an iron kettle. I will further say on the subject of dams that a large waste weir and fine screen upon it are indispensable to retaining small as well as large fish in small ponds.

My pond covers an area of about one and a half acres, and the water at first stood upon the natural ground—grass, sod, stumps, marsh land, and all—as it was after partial clearing and improvement for agricultural purposes; the lower portion consisting of stony, gravelly bottom, and the upper half consisting of muck and clay, which soon produced a great quantity of flags in the water, and a great variety of weeds as well as cranberry vines around the shores. After my third failure in raising fish, viz, first with trout, next with catfish or bullheads, and finally with suckers, as described below, I made the improvement in the dam above referred to. At the same time I removed the soil and muck, stumps, &c., from the lower half of the pond, and deepened and cleaned the margins of this part to a depth of about 2 feet along the shores. I then built two stone walls, 2 feet high, equidistant from the shore and each other, extending from near the dam up stream 60 feet, with a depth of 6 feet of water between them; thence I continued two other walls up stream, about 3 feet apart, in the center of the pond, and covered them with flagstones. This structure is about 18 inches high, with an average depth of 4 feet of water, and extends to where the muck and flags still remain as feeding grounds and shelter. Leaving the pond at this point, and running around it, is a canal or conduit, 18 inches deep and 3 feet wide, branching at the head of the pond. Each branch originates in a principal spring, always affording fresh running water. These conduits are lined on either side with flagstones, lying horizontally, about 4 to 6 inches from the bottom, as shelter. The banks of these canals are also partially lined already with shrubbery as shelter for the fishes, and are intended to be fully so.

As a matter of usefulness a pond on each farm will pay interest on cost of construction aside from fish culture. I filled my inclosure last winter with about 14 tons of ice in less than a day, whereas it would have taken more than two days to have taken it from any other waters near me; also, by constructing a gate, flume, and sheep-box for washing sheep, two men and a boy washed well one hundred and one sheep this spring in four and a half hours, thus saving three or four times the expense of driving off of the farm for washing. In the near future I propose putting down a hydraulic ram to supply my buildings with water.

In the month of August, 1863 or 1864, I placed in my then new pond 240 trout caught in Roaring Brook and Kellam's Creek, differing in color, of course, according to the color of the bottom of the streams from which they were taken. There were in the pond an abundant supply of places of refuge for the smaller trout. The lot varied from 3 to 8 inches in length. I then commenced feeding them on liver, veal, beef, mutton, and some angle-worms. In September and October they made beds around gravelly shores, and I have reason to believe they hatched more young fish than they devoured. The next summer, in June, the indications of increase were quite apparent, notwithstanding an overflowing of the pond by which many escaped, caused by a sudden heavy shower and too small a waste wier. The next season I began to catch a moderate supply for the table, and they were flavorless brook trout. The next season I drew the pond down to dry the banks for cultivation on the 25th of June, and on the 5th of July shut the gate. The sun was excessively hot, and when the water began to run over, about the 8th, it looked milky, and in less than ten days I experienced a loss of about 3,500 trout, without one living one being left. Many persons thought they were poisoned by evil persons, which might have easily been done, as when trout get accustomed to being fed they become exceedingly tame, and at meal time every fish puts in an appearance; but it seems much more likely to me that the banks had, from the excessive heat, become putrid and poisoned the water, which poisoned the fish, and when once affected in that way all the pure water in the world will not restore them.

I then had learned that fish, especially trout, needed a different pond, and determined in the near future to rebuild, but, to await a convenient time for that work, stocked the water with a few catfish. In a couple of years I had enough in numbers to supply a dozen family ponds, but they never grew to any practical size; and the third year after putting in the catfish I put in 84 white suckers, in the spring of the year. After retaining them and the catfish together two winters, and having trouble with the muskrats both winters, I scuttled the dam, took out 40 suckers, all told, about double the size that they were when put in, and let the catfish go down stream, and gave them one whole year's time to be sure they all escaped. They are nocturnal in their habits and will destroy other fish that stop at nights.

After rebuilding, as first described, on October 9, 1877, though late in the season, I commenced restocking the pond with trout from Roaring Brook, Kellam's Creek, and Spring Brook. This was their spawning season that year and many of the males were decked in gorgeous colors. I put in the pond between 200 and 300 trout, and during that fall and winter put in also 900 other fish, small fry as well as some of larger pretension, viz, shiners, horned chubs, white chubs, striped and speckled dace, suckers, one perch, one sunfish, and several other varieties that I never heard named; and then my real success with a self-sustaining trout pond commenced. It is called now *Glen Mere*. After stocking this time, I commenced feeding entirely with angle-worms, which I readily procured of the boys and even girls and some women, at five cents per quart; not only feeding for the time being, but laying away in dirt, in boxes in the cellar, for winter use. I, conceiving this to be the best artificial fish-food for most kinds of fish, commenced preparing a plat of ground on the side of the pond for its culture. Where the ground is uniformly moist and made mellow and rich these worms can be produced in immense quantities, but I have never needed any of this kind of food after the first winter. The next spring the trout-food fish produced such immense numbers of young fish that after the food natural to such waters was exhausted the trout had nothing to do but turn their attention to their less royal brethren.

Most of these small fish are vegetarian, either from necessity or choice, and when they have cleared the waters of the frog spawn, &c., I feed them on boiled wheat-bran, made thick and molded into loaves. They will, in my pond, when other food is scarce, devour four loaves in five days as large as common bread pans will hold heaped up. Many of these fish escape the trout, and grow to be fine table-fish, for which purpose we use many of them. The trout are always fine and in good condition without any care as to food, and as wild as any brook trout that I ever saw. They and the suckers now hatch their own young in the canals above described, and the other fish in the gravelly banks along the shores of the main waters. The perch and sunfish that I put in with the small fish grew finely; the former grew in two years from about three inches long to about ten inches, and he was a fine old bachelor fish to eat; the latter became, in one year, about four times larger than when put in. The perch as well as the trout is carnivorous, and it is a question in my mind whether it would or would not excel the trout for domestic fish culture or whether there are other kinds which will excel either. Catfish are largely vegetable eaters in their food, and with my present experience I think I might have done better with them by correct feeding.

Suckers extract their food from the mud in the pond, but what that food is I never could learn; have feared it might in part be on other fish eggs, and they should be excluded; but in such waters as mine (entirely spring water) they make a very good breakfast when well prepared for the table.

Out of 200 acres comprising my home (called Glenhouse), I have no acre outside of my gardens and fruit land but what I would miss less than my trout pond. With probably not more than $200 outlay, consisting of labor and money, I now have a fair supply for a large family of fresh fish of excellent quality; gather my ice and wash my sheep at probably less than one-third of what would be the cost without it; and raise on three small islands in the pond more cranberries than we can use, besides the frogs it produces during their season. Then, in addition to great improvement in the landscape by the mingling of water in it, to me it seems like money well expended, and I know of no branch of farming industry that will bring better returns in proportion to the care bestowed and money expended. I have shut in a small pen a few trout and fed to them all the angle-worms and small fish they would eat, and their growth has been as rapid and remunerative in proportion to the expense as any swine or poultry I have ever had fed. But I am now, whilst writing this, learning a new lesson which I ought to have anticipated, and probably would if I had been manipulating any other kind of farm stock. With our experience with sheep, horn cattle or horses we would not have expected a uniform supply or increase by simply stocking up with a full quota of the proper gender of each kind to start with, but we would have used art in maintaining conditions in regard to seasons, and made every other necessary special effort to see that the means used were successful. My trout from some cause utterly failed to produce any young ones last fall and winter, and my pond will have to be restocked by art, or I will have to take the doubtful chances of a better crop this winter. It may so occur with this kind of fish in their natural waters; I am inclined to think it does, and hence a variable supply in our streams. My screen at the weir may have allowed them all to pass out of the pond and should be finer. I have never propagated fish by artificial means, but am now inclined to believe that, in order to be uniformly successful with trout culture, artificial hatching will have to be included. As to a self-sustaining fish pond being practicable and profitable to farmers and others I have no doubt. Carnivorous fish can be raised successfully with other and smaller ones that live largely upon vegetable growths in the water. The latter are easily supplied with vegetable food when they need it, and angle-worms can be cheaply produced to feed the former when they need them, in addition to the food already in the water or produced there. It pays well to feed both kinds well.

I fancy you might wish to ask one question, and that is, how I can feed different kinds of fish living in the same ponds on food suitable for each and different in the kind. My answer would be that a goose would not go to share a meal with a fox, or a chicken with a hawk. When the fox and hawk were gone the others might pick up some of the crumbs, and the food for the chicken and goose would not be sought after by others.

DUNNINGS, PA., *June* 16, 1881.

79.—OBSTRUCTIONS TO SALMON IN PEND D'OREILLE RIVER, MONTANA, REQUIRING A FISHWAY OR REMOVAL OF FALLS.

By E. B. WATERBURY, et al.

[From letters to Hon. Martin Maginnis, M. C.]

A scheme of which you are no doubt aware is on foot to open a fishway around Peu d'Orielle [Pend d'Oreille?] Falls, to admit of the ascent of salmon to all our streams tributary to Clark's Fork. The falls are 22 miles above the mouth of Peu d'Orielle, at the lower end of a cañon, which cañon is said to be 10 miles long. There are other rapids and falls, but none which salmon cannot easily overcome between here and the Pacific.

I need not attempt the discovery of advantages to you who know the broad country they would be distributed over, but will say this much from observation: I have seen smaller streams than Flint Creek so crowded with ascending salmon as to crowd the ones uppermost out of water and make the stream overflow its banks. Forty-pound fish are large fish for so small a stream, yet they fight hard for headwaters. The falls are in Stevens County, Washington Territory, 50 miles above Fort Colville, which is on the Columbia. I think Gov. J. J. Stevens gives some account of them in his reports at an early day.

While in the Idaho legislature I prepared a bill for this purpose, but as Idaho could reap but little benefit, and Montana was then about to have a separate Territorial government, the members thought it not necessary at that time, and I did not introduce it. I cannot conceive of a more popular and lasting move than your obtaining from Congress an appropriation of, say, $10,000 to construct a salmon-way around those falls. The benefit cannot be properly estimated. After a couple of years, or say five, it would be worth $200,000 a year to the people of the Territory, to say nothing of furnishing all the Indians with their winter and most of their summer food. Our legislature, you will recollect, appropriated $1,000 at its last session, but that would only answer to get a survey when used, and Roth is of opinion a permit should be obtained from the legislature of that Territory. But I am convinced the Territory will do nothing, the obstruction being situated so far out of its limits and in a secluded place. I am convinced a smaller amount of money would construct a temporary fishway, but believe $10,000 could be spent in rendering it permanent for years.

It is unnecessary for me to add that could you get such an appropriation the benefits to be derived from it could not be over-estimated nor over-represented. It will cause a pleasurable sensation over the whole west side of the mountains to read of such a move on your part in their interest, and you will have no opposition from any quarter.

Every military man, every officer of the Government, particularly Indian agents, as well as ranchers, miners, and others, will be delighted with these great edible fish at their doors. The officers at Fort Colville, or James O'Neil, agent of Colville Indians there, would gladly give you any information in their power.

CLEAR CREEK, MONT., *April* 9, 1880.

Under date of March 20, 1880, Granville Stuart, vice-president of the Helena (Montana) Rod and Gun Club, also wrote:

"Will you be so kind as to use your influence with Congress to have them pass a resolution allowing Montana to remove the obstruction at the Great Falls of the Pen d'Orielle [Pend d'Oreille?] River to such an extent as to allow the salmon fish to ascend the various streams of Western Montana, and authorize us to expend $3,000 by legislative appropriation for this purpose? The obstruction is either in Washington Territory or Idaho. In the absence of any survey we cannot tell which. Of course the General Government should do this removing for us, but knowing that *that* is hopeless, we only beg permission to do it ourselves."

Messrs. J. C. Robinson, W. W. Botkin, and E. S. Paxson, a committee appointed by the Deer Lodge (Montana Territory) Rod and Gun Club, wrote under date of March 30, 1880:

"The undersigned, a committee appointed by the Deer Lodge Rod and Gun Club for the purpose, &c., represent that at the last session of our legislature an appropriation of $1,000 was made for the purpose of so removing the obstructions in the Pen de Orielle River [Pend d'Oreille?], known as Kettle Falls, which prevent salmon fish from running up into the Hall Gate [Hell Gate or Hellgate?] and its tributaries; that the governor of Montana, who by the act is entrusted with its expenditure, claims that, before it can be done, a resolution of Congress authorizing it, or permitting an interference with the falls, will be necessary, especially as we think those falls are in Idaho, beyond our Territorial limits. It was thought that $1,000 would be sufficient, but now it is believed that it will require probably $2,000. We therefore ask that you use your efforts to procure the passage of a resolution authorizing the blasting out the falls so that fish can run up the river, and if you think there is any chance to do so, procure the appropriation of an additional $1,000 to aid in the work."

Mr. B. H. Tatem, secretary of the Helena Rod and Gun Club, wrote, April 3, 1880:

"The Rod and Gun Club of Helena have lately learned that the appropriation of $1,000 for the improvement of Little Falls cannot be expended until Congress authorizes Governor Potts to do so, and at a late meeting the following resolution was unanimously adopted:

"'*Resolved*, That the Helena Rod and Gun Club, being desirous of the improvement of Little Falls, and learning that the appropriation

therefor is unavailable because of the want of legislation, respectfully request Hon. Martin Maginnis to use his best endeavors to obtain such legislation as may be needed.'"

On the 20th of April, 1880, Mr. Frank H. Woody, of Missoula, Mont., wrote as follows:

"At a recent meeting of the Rod and Gun Club of Missoula, Mont., a committee, consisting of Lieut. Col. George Gibson, U. S. A., Hon. W. J. McCormick, and the undersigned, was appointed to communicate with you in reference to the removal of certain falls in the Columbia River, in order that salmon might ascend the headwaters of said river. These falls are situated in either Washington or Idaho, the exact location of them being unknown to the committee. The last regular session of our legislature appropriated $1,000 for the removal of these obstructions, but Governor Potts holds that the money cannot be used for that purpose until the Government of the United States grants permission for the removal of said falls. Now, what our club desires in the premises is this: That you, by some means, if practicable, procure the necessary permission for the removal of said obstructions, if you upon making the necessary inquiries find that such permission is necessary. I write this at the request of Colonel Gibson, who is chairman of the committee."

80.—SUPPOSED OCCURRENCE OF SAIL-FISH, HISTIOPHORUS.

By Capt. WILLIAM M. BARNES.

[From a letter to J. T. Brown.]

The Pacific Ocean has been my cruising-ground for nearly thirty years, and several years have been spent near the line, from the South American coast westward to the Salomon Islands. My first and only sight of the *fish* was, I believe, in 1876, near Chatham Island, one of the Gallipagos group. We were perhaps 10 miles from the island, and were passing to windward of it, when our attention was attracted by an unusual object a mile off. Looking at it with a glass we saw the fin of some sort of a fish, having the appearance of a sail. As nearly as I now can tell the sail was all the time above water, just as if it had been the sail of a low boat or canoe, and continually rolling from one side to the other just as if it had belonged to a boat that was running before a small swell. The sight was so interesting that we tried to make a near acquaintance with this sort of craft, and I dropped down my first officer with his boat to catch the stranger. The mate put up his sail and ran down to the fish, which all the while had been sailing slowly toward the island. Just before the boat was within striking distance the fin disappeared, and a few minutes after it was up again a little way from the boat. My mate attempted a second time to get the boat within striking distance, and again the fin disappeared. After making a num-

ber of attempts with the same result the mate gave up the chase. The fish* then went leisurely on his course down toward the island, and we went off another way on ours. I have often mentioned this incident to whalemen who had spent years in cruising along the line, but have not met one who had seen anything similar.

I have heard of a "sail-fish," and supposed that this must have been one of that species, whatever that may be. Also, I had on board an edition of Chambers' Encyclopedia, which described the "sail-fish" as a kind of shark.

Last winter I was running to westward along the line in the Pacific and in February was at "Ocean Island," or "Paanopa," a small lone island 40 miles south of the line, in east longitude 170°.

There we were boarded by several canoes, and from one I procured parts of a fish that possibly may have been of the same kind as the one at Chatham Island. But this was some kind of a fish with a bill. Now we quite often see a kind of bill-fish, but never with such large dorsal fins as these. I imagine that this must have been a small specimen. I brought home the parts I was able to procure. The bill is twenty inches in length, cut off close to the head. I have only a part of the dorsal fin, and not in good condition. The longest spines are thirty inches long, and there is a little more than three feet of the fin. The membrane between the spines is badly torn. This membrane is quite thin. There are also two pectoral fins.

Now, this may have been quite a different fish from the one I saw first, but it struck me as being a smaller one of the same kind, and I have quite a curiosity to ascertain what is known of similar fishes.

NASHUA, N. H., *January*, 1882.

81.—FITTING OUT WITH COD GILL-NETS.

By S. J. MARTIN.

[From a letter to A. H. Clark.]

Most all the Ipswich Bay fleet are getting cod gill-nets; there are ten that I know of from Gloucester. They have got some at Swampscott, some at Portsmouth. Some of them are having their nets 2 fathoms deep and 75 fathoms long; I think that is an improvement in shoal water. The nets have made a great stir here. Joe Simpson, Frank Maker, and Bill Coas, net-makers of Gloucester, are at work on cod gill-nets. Some of the vessels won't get their nets till the last of February. There are ten vessels that will average twenty-four nets to a vessel. Average length, 60 fathoms. That is for Gloucester alone.

GLOUCESTER, MASS., *January* 28, 1881.

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*Dr. T. H. Bean says of this: "It seems highly probable from Captain Barnes' description that the fish was a *Histiophorus*. The genus is found in the region referred to."—EDITOR.

82.—NOTES ON THE PACIFIC COAST TRADE IN SHELLS, SHRIMPS, COD, AND SALMON.

By WILLIAM H. DALL.

Exports by sea from San Francisco, Cal., during the year 1882.

Destination.	Haliotis shell.	Pearl oyster.	Other shells.	Dry shrimps and shrimp shells.	Cod.	Salmon.
	Sacks.	*Barrels.*	*Packages.*	*Packages.*	*Packages.*	*Packages.*
Australia	.....	.....	.....	.....	8,057	53,254
British Columbia	.....	.....	.....	.....	582	.....
Cape Town, South Africa	.....	.....	.....	.....	.....	700
China	1,116	.....	.....	9,611	941	486
England	2,982	563	49	.....	.....	58,705
Germany	50	.....	.....	.....	.....	.....
Hawaiian Islands	65	.....	.....	8	1,486	7,063
Japan	.....	.....	.....	.....	128	192
Mexico	.....	.....	.....	.....	272	359
New York	425	.....	2	.....	.....	13,772
New Zealand	.....	.....	.....	.....	.....	7,560
South America	.....	.....	.....	99	.....	40
Other countries	.....	.....	.....	.....	231	5,142
Total	4,638	563	51	9,718	11,697	147,273

The above table is compiled from data scattered through the Annual Market Review, San Francisco, January, 1883. The value of the Haliotis pearl shells (*abalones*) was $23,455, a slight increase over 1881. The value of the salmon is given as $794,593, though, owing to the existence of a few misprints, the collected details as printed sum up rather less. From 1870 to 1882, inclusive, the period covering the Californian canned salmon industry, 1,726,832 packages, of two dozen cans each, have been exported by sea from that State, valued at $9,993,211.

Of cod, 709,000 came from Siberian and 577,000 from Alaskan waters.

Entire accuracy cannot be and is not claimed for these figures.

Exports by rail are not included. Over 10,000 pounds of Haliotis shells went east by rail in the last month of 1882.

The dry shrimps are caught in nets, dried on a mat over a fire, thrashed, winnowed, and put up in packages by the Chinese in California. The meats are used as food, the shells as a very potent fertilizer. The latter all go to China, but the Chinese in the Sandwich Islands and South America import a small amount of the dry shrimp meats from San Francisco.

The Haliotis is *H. rufescens* and *H. cracherodii* chiefly, known locally as "abalones," a corruption of the Spanish "orejones," sea ears.

The pearl oyster is the *Meleagrina californica* Gr., and comes from Lower Californian waters solely—mostly from the Gulf of California. Other dry shells are exported for ornamental purposes, some being pearly and others merely used in shell-work, &c.

83.—REPORT FOR 1879 AND 1880 OF THE SALE OF FISH IN FULTON MARKET, NEW YORK.

[From the New York Market Index and Journal, April 3, 1880.]

FISH, ETC., BY POUNDS.

Kinds of fish.	March 1, 1878, to March 1, 1879.	March 1, 1879, to March 1, 1880.
Flounders	1,544,842	1,705,989
Halibut	3,327,790	3,549,121
Codfish	8,636,479	8,719,574
Pollock	222,908	315,879
Haddock	1,857,790	1,813,820
Frostfish	53,792	77,871
Blackfish	188,981	199,530
Spanish mackerel	275,163	310,970
Weakfish	510,022	801,017
Kingfish	38,090	38,447
Sheepshead	82,474	67,325
Porgies	2,198,780	2,388,863
Sea bass	446,695	255,688
Striped bass	716,642	678,423
Blue-fish	3,843,983	3,570,543
Smelts	1,560,541	1,589,268
Salmon	436,623	394,220
Herring	942,145	1,052,891
Eels	1,202,414	1,292,917
Sturgeon	70,633	68,858
Black-bass	79,850	85,011
Pickerel	508,131	744,566
Yellow pike	173,367	129,251
Siacoe	629,661	624,438
White fish	741,942	693,085
Brook trout	6,522	8,139
Salmon trout	84,262	96,160
Catfish	98,562	52,847
Salmon, fresh-water	506,719	446,411
Green turtles	6,103	8,189
Lobsters	1,625,655	1,737,224
Salt-water fish	912,199	670,131
Total	33,529,960	34,276,666

FISH BY COUNT.

Mackerel	2,317,763	3,827,324
Shad	661,594	953,439
Scollops	46,551	36,445

Herring, frozen, of which there was no account in the year 1878, but was in the year 1879, 1,001,520 pounds. The decrease in bluefish for the past year is owing to none being taken in Southern waters off the coast of North Carolina, as the fishing there in the months of November and December of 1879 was a complete failure. The decrease in striped bass is owing, in a great measure, to the law passed by the legislature of the State of New York in 1878, prohibiting the taking, or having for sale, any bass of less weight than one-half pound.

The increase in weakfish has been very large the last year—almost 300,000 pounds—a large quantity being caught on the coast of New Jersey, where, the year before, hardly any were taken. The increase in shad is also quite large in 1879. Fulton Market does not receive

more than one-half of the shad caught in the Hudson River, but does receive a large portion of what is caught in the Connecticut River, and possibly Fulton Market in 1879 received a larger portion than the year previous.

84.—DESCRIPTION OF A CALIFORNIA SALMON (ONCORHYNCHUS SP.) FOUND IN ONE OF THE RIVERS OF NEW ZEALAND, AND IDENTIFIED BY DR. T. H. BEAN.

By S. C. FARR,

*Secretary and Treasurer of the Canterbury Acclimatization Society.**

Many unavoidable causes have prevented me from addressing you at an earlier date on the question relating to the fish caught in one of our rivers, although I have been very anxious to have the question set at rest if possible.

The following is the description as near as I could collect from the fish about eight hours after it was taken, and the photograph was taken from a sketch I made some time after it had been in spirits: Length, one foot ten and a half inches; girth at the shoulder, one foot three inches; weight, 8 pounds; color, olive green on the back, the sides lighter, the belly silvery white, the sheen of the scales very bright, intermingled with irregular spots of a brownish olive tint both above and below the lateral line. Teeth very small but numerous, five rows on the upper surface of the mouth; the central one is short, having only two in each row, turning outwards alternately to each side. There is one row on each side of the under jaw, while there are more to be seen on the tongue. The scales in the center of the side are about one-eighth of an inch in diameter and cycloidal. The caudal fin has 19 rays; anal, 15; dorsal, 13; pectoral, 16; and ventral, 9. The color of the flesh is a bright pink.

I trust the above will sufficiently describe the fish to enable you to decide its genus in such a way as will remove all questionable doubts.

CANTERBURY ACCLIMATIZATION SOCIETY,

Christchurch, April 20, 1882.

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*The letter here printed was addressed to the United States Commissioner of Fish and Fisheries, and was accompanied by a photograph, which was made from a sketch taken from the preserved fish some time after its immersion in spirits. This photograph, while it may readily be recognized as representing a species of *Oncorhynchus*, would be more valuable had it been taken from the fish itself, and with the dorsal and anal fins so extended as to show the number of rays; the size of the scales, also, could then have been determined. The enumeration of the fin rays by Mr. Farr, however, and his remarks about the teeth, taken in connection with the photograph, leave no doubt in my mind that the captured fish is a California salmon, belonging to the species introduced in 1874 (or 1875?), and subsequent years, by the United States Fish Commission. Mr. Farr's photograph bears the date July 10, 1880. —TARLETON H. BEAN.

85.—THE ARTIFICIAL RAISING OF COD IN AMERICA.

[From *Deutsche Fischerei-Zeitung*, Vol. V, No. 46, Stettin, November 14, 1882.]*

In an October number, the Republican Journal, published in Belfast, Me., says: "The United States Commissioner of Fish and Fisheries is at present engaged in various experiments in the hatching of fish in an artificial manner at Wood's Holl, where work of this kind has been done for several years. In former years experiments were made at Gloucester in the artificial hatching of cod, and several millions of young fry of the cod have been placed in the water there. A large number of young fry also were placed in the sea among the rocks near Wood's Holl. Since that time nothing has been heard or seen of this fry until recently, when fishermen reported that enormous numbers of small codfish, measuring 4 to 6 inches in length, were swarming in the waters off the mouth of the Piscataqua, in the neighborhood of Portsmouth.

"As these schools of quite small fish are a phenomenon hitherto unknown in these regions, competent persons have declared them to be the first visible results of the experiments in artificially hatching cod made at the Government expense under the direction of Professor Baird. It is supposed, and with good reason, that these small codfish found on the coast near Portsmouth were really hatched in the Government hatcheries near Gloucester and Wood's Holl, and that, following their natural desire to get into cooler water, they moved further north. If this supposition, as can hardly be doubted, is correct, the result of the above-mentioned experiments must be considered as quite successful, and will doubtless cause people to take the necessary measures for stocking the coast waters from Cape Cod to the Bay of Fundy with millions of cod, such as were present in former times, before the fishermen, by their endeavors to make a living, nearly exhausted this portion of the Atlantic Coast of its enormous wealth of food-fish.

"If we succeed in finding means to maintain a large number of codfish near our coasts by artificial hatching the importance and the yield of the so-called coast fisheries, which during the last fifty years has risen from a few cargoes caught during the winter to 30,000,000 pounds in one port alone, will doubtless be doubled in the course of a few years. The efforts made in this direction by the Government will then be richly rewarded, and Professor Baird will have accomplished a great and good work."

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* *Die Künstliche Dorschzucht in America.* Translated from the German by HERMANN JACOBSON.

86.—NOTES ON THE BIOLOGY OF THE SALMON AND GRILSE.

By JOHN ANDERSON.

[From a letter to Prof. S. F. Baird.]

I have had salmon fisheries to the tune of £2,000 a year for upwards of forty years. I have had also large connections with white fishermen, and for thirty years had upwards of 200 men engaged for turbot, cod, brill, and soles. During many years I have had great experience in examining what the various fishes lived on both in the sea and river, as also in the lakes.

Most people hold that the grilse is the young of the salmon. I say it is not. It is never seen on our coast till the month of May, and then it weighs 1½ to 3 pounds, while in February we have the young of the salmon in our rivers weighing from 1½ to 3 pounds. The salmon, if you examine it, has an oval scale, a crescent-shaped tail, and quite a different shaped body. The grilse has a diamond scale, a mackerel-shaped tail, and its teeth are quite differently placed from those of the salmon on the river Forth, where I had my fisheries. I have had in one morning 300 grilse, and among them upwards of 30 which exceeded 16 pounds each in weight. At the same time there were 60 salmon, many not over 8 pounds in weight, and some as high as 50 pounds. I have pointed out to skeptics grilse of the second year of fully 22 pounds weight, and which still retained all the above marks.

We have a salmon hatchery on the river Tay. The keeper seemed astonished to find fully one-half of his young family seemingly anxious to get to sea, while the other half were quite contented to remain in such good quarters. In November, when they capture the fish to take the spawn from them, it is generally broken weather and often the river is covered with ice or icicles, and the men getting hold of a 12 or 16 pound fish never look to see whether it is an old grilse or a salmon. Thus all get mixed together. This accounts for the half seeking to go to sea sooner than their neighbors. Then as the salmon fry seek the sea a few months earlier, it is natural for them next season to return a few months earlier than the grilse.

In some of our rivers we obtain 30 grilse for every salmon. On a portion of our sea-coast for a distance of 100 miles, they do not get 100 salmon with the 3,000 grilse caught during the season. There is another river where any quantity of fine salmon-trout are had and at times a good fine grilse, but scarcely 6 during the season.

Some people, and those in high positions, deny that salmon eat anything while in the fresh water, but I have myself found hundreds of times from three to eleven young herring in them during June, July, and

August. I have also found in them sand-eels. This is a small fish as clear as a herring, but long and thin, and buries itself in a moment in the sand whenever it hears or sees an enemy approaching. At times it is caught for bait for the white fishermen's lines with a very small meshed net, and in large quantities. I have also found in them young parr and trout, and frequently perch and minnows.

DENHAM GREEN, *Trinity, Edinburgh, December* 18, 1882.

87.—A NOTE ON THE ATLANTIC SPECIES OF THE GENUS ANGUILLA.

By SETH E. MEEK.

In the Synopsis of the Fishes of North America by Jordan & Gilbert, two species of the genus *Anguilla* are recorded, *Anguilla rostrata*, the American, and *Anguilla vulgaris*, the European, species. With a view to testing the value of the characters assumed to distinguish these two species I have carefully compared several specimens from both sides of the Atlantic.

In the American specimens, the dorsal fin is proportionately farther from the end of snout, making the distance between front of dorsal and front of anal a little shorter than in the European specimens. Otherwise no permanent difference seems to exist. We should not, therefore, in my opinion, consider the two as distinct species, but rather as geographical varieties of the same species. Below is given a table of eleven specimens, seven European and four American. The proportions are given in hundredths of the length to the end of last vertebra. All the specimens mentioned are in the collection of Jordan and Gilbert.

Dimensions.	LOCALITIES.												
	ropean examples, *Anguilla vulgaris* (Shaw).								American examples subs. *rostrata* (Le Sueur).				
	Genoa.	Genoa.	Paris.	Venice.	Venice.	Venice.	Venice.	Average.	Average.	Wood's Holl, Mass.	Wood's Holl, Mass.	Indian River, Fla.	Pensacola, Fla.
Length of head	13¾	13⅜	12	13	12¾	12½	14¾	13.2	13.8	11½	13	13¾	12½
Distance from end of snout to front of dorsal	31	30¼	30	31¼	30	29¼	31¾	30.5	33.0	29⅝	33¾	35½	33½
Distance from end of snout to front of anal	45	43	44¼	43	42½	43¼	46	43.8	43.7	41¼	44¼	46	43¼
Distance from front of dorsal to front of anal	14	13¼	14¼	12¾	12½	14	14¼	13.6	10.6	11¾	10½	10½	9¾
Length of mandible	5¾	6	5	5½	5	5	6	5.5	5.3	4¾	5½	6	5
Length of pectoral	4	3¾	4	4	4	4	4½	4.0	4.0	4	4	4	4¼
Depth of body at front of anal	5¼	5	5½	5	5	5½	5¾	5.2	5.5	5½	5	5½	6¼
Distance from gills to vent	27¾	28¾	32	29¼	29½	30	30½	29.6	30.5	29½	32	30½	30
Length in inches	16⅞	16½	20⅛	11⅛	12¾	12⅝	23⅛	.....	.....	12½	13⅝	10⅝	10⅝

INDIANA UNIVERSITY, *May* 11, 1883.

88.—UNEXPLAINED VARIATIONS IN THE YIELD OF OIL FROM COD LIVERS.

By W. H. SCHIEFFELIN & CO.

[From letter to Prof. S. F. Baird.]

The result of the cod-fishery on the Norwegian coast this season is remarkable. We are at a loss to account for such a state of affairs. A letter from Bergen, dated March 6, states the result of the fishery up to this day as follows:

Year ending—	Number of cod taken.	Barrels of liver obtained.	Barrels of white oil.
March 5, 1881	13,000,000	27,500	1,400
March 5, 1882	5,500,000	7,650	240
March 5, 1883	6,000,000	4,100	180

Usually 250 to 400 codfish give 1 barrel of liver. This year, from 700 to 1,100 are wanted. Usually 2 barrels of liver give 1 barrel of oil. This year, 4 or 5 barrels of liver are wanted.

172 WILLIAM STREET, NEW YORK, *April* 2, 1883.

89.—UNEXPLAINED VARIATIONS IN THE YIELD OF OIL FROM COD LIVERS.

By Capt. N. E. ATWOOD.

[From letter to Prof. S. F. Baird, written upon reading the foregoing letter.]

In my long experience in the fisheries of this locality I have given much attention to the condition of the livers of cod, but more especially so since 1849 when I commenced to manufacture cod-liver oil for medicinal purposes. I have bought the livers as they came in fresh every winter since that time.

The winter school of cod usually comes in here in December and stops until March. In former years there seemed to be no great difference in the condition and quality of the livers from year to year. I think it took from 2½ to 3 barrels of livers to yield a barrel of oil until about 1872. For several winters after, we had a large school of excellent cod visit us; indeed, the best I have ever seen. Their livers yielded a large quantity of excellent oil. It took only 2 to 2½ barrels of livers for a barrel of oil. During the winter ending March, 1878, we had an abundance of cod, but they were thin and poor when compared with those of former years. In their mouths we occasionally found such hooks as are used by the French fishermen on the banks of Newfound-

land. I found their livers poorer than any I had seen here at any time before. I bought 200 barrels of livers, from which I got only about 50 barrels of oil, thus requiring 4 barrels of livers for one of oil. Since that time there have been very few cod taken here. They have been very scarce and their livers have been very poor, requiring from 4 to 6 barrels to furnish a barrel of oil. Last winter a few fish came in having better livers, which required only about 3 to 3½ barrels of livers for a barrel of oil. We think the prospect looks better, and we hope when they come again they will be equal to any former year.

I am at a loss to account for this state of things. It may have been caused by the scarcity of food in the locality where they spent their time when away from us.

PROVINCETOWN, MASS., *April* 21, 1883.

90.—A NEW PROCESS OF DRYING FISH.

[From the Cape Ann Advertiser, about February 25, 1883.]

On Tuesday we visited the establishment of Mr. R. S. Jennings,* at Vincent's Point, in the building formerly occupied by the Cape Ann Anchor Works, where this gentleman has put into practical operation his process for the artificial drying of fish. He has two apartments fitted up with flakes, the floors of which are partially open to allow the air to circulate. By means of fans, which are operated by steam power, the moisture is removed from the air and applied to the fish to be dried, drying them in a few hours in a perfectly satisfactory manner. By the use of the process, fish-making may be as rapidly and cheaply effected in wet as in dry weather, and in dog-days as in October, and the work may be continued night and day. Fish may be taken from the pickle in the morning of the worst drying day in the year, and dried and shipped before noon, if desired. The fish are perfectly faced, and are whiter and brighter than can be produced on out-door flakes. They are necessarily cleaner, being entirely free from dust, sand, and dirt, and no practical fish maker need be told that the weight of the fish when dried is in favor of the process, as it is a well-known fact that the quicker a fish is dried the less it shrinks in weight. We feel assured that this process will soon come into general use, thereby making available for other purposes the land now used for fish flakes, and preventing the annoyance and losses now experienced in curing fish during certain seasons of the year. The most searching investigation of the practicability of this process is invited. The expense is warranted to be less per quintal than it costs to dry them out of doors in the best drying weather.

*A copy of Mr. Jennings' claim filed in the Patent Office will be found on page 336 of this volume.—C. W. S.

Vol. III, No. 28. Washington, D. C. Dec. 7, 1883.

91.—THE ZOOLOGICAL STATION AT NAPLES, ITALY.

By Prof. ANTON DOHRN.

[From a letter to Prof. S. F. Baird.]

Inasmuch as I have thrown my whole existence into the creation of zoological stations, I shall give you all the information I am able. You are right in supposing that there is no description of the establishment which I have founded here. General descriptions exist in almost all European languages, since the zoological station offers a charming occasion for newspaper articles. But such descriptions would not help you a bit, as they leave out all that is technically important.

I think it advisable to send you a series of photographs which have been made lately for a present at the silver wedding of the German crown prince and crown princess. Both have been very intimate with every particular of my enterprise from its very beginning. Both make visits to the zoological station, and I have the honor of giving them annually a verbal and several written communications on the progress of the establishment.

Perhaps you know from earlier communications that I have introduced a system of so-called "tables," which forms the basis both for the scientific use and for the maintenance of the station. A table means the right to occupy a working table in the laboratory of the station, and to use all the help which is offered by the entire establishment. Such tables are paid for by different Governments, with 2,000 francs per annum. Italy has hired 4 tables, Prussia 3, Saxony, Bavaria, Wurtemberg, Baden, Hesse and Hamburg together each 1, Russia 2, Holland 1, Belgium 1, Switzerland 1, Hungary 1, the University of Cambridge 1, the British Association 1, University of Strasburg 1, Berlin Academy 1. The latter gave me a steam yacht in exchange for ten years use of a table, and Strasburg keeps its table for fifteen years as recompense for 100,000 marks being put into my establishment by the German Imperial Government.

The United States are not represented. I believe I wrote some years ago to you about this; certainly I sent Professor Agassiz an account of it. Several American naturalists have applied for admission. Some months ago Professor Huxley asked me to permit a pupil of his, Miss Nunn from Ohio, to occupy one of the English tables. I told him that I could not do so, except as a special kindness to him, since the English tables were only to be occupied by Englishmen. He requested that special favor, for at least a few weeks, till an Englishman could be appointed. This being now the case, Miss Nunn having also expressed most urgently her desire to be permitted to continue her work here, I am at a loss what to do. I ought to send her away. That is a duty

imposed upon me by all those who pay regularly for a table even when it is not occupied a year or more. Some weeks ago I got another application, from Mr. Wilson, of the Johns Hopkins University. He wished especially to obtain the method of microscopical work used in the station. He says that he has no claim to a table, but hopes I may be able to find him a way out of his difficulty. A year ago Dr. Whitman, who was in Japan, came here to ask the same favor. I permitted him to work here as my personal guest. Dr. Scott, from Princeton College, told me he would have some students, too, if America had a table. Others have told me the same. I should be only too glad if I could permit all of them to study here. I believe there is now no laboratory in the world which offers such a combination of means, both technical and other, as the Naples station. But I must stick to my rules and laws in order to maintain the existence and further development of the institution.

I think now there is nobody in America in a better position to regulate this affair than yourself. Is it not possible for the Smithsonian Institution, or the National Museum, or the United States Commission of Fish and Fisheries to keep permanently a table in the Naples station? I have written to Dr. Wilson, also, to try to persuade the Johns Hopkins and Princeton Universities and Harvard College to combine and have a table.* I believe it would be a mutual benefit if such could be brought about. The price of a table per annum is 2,000 francs, or £80, a sum which certainly does not exceed the financial powers of American institutions. Miss Nunn told me that she had asked Dr. Scudder and Professor Hyatt to help in this matter.

The zoological station is a purely private enterprise, for which I am alone responsible. Besides the income of the twenty-one tables, it derives annually 30,000 francs from the entrance fees to the aquarium, and 10,000 to 15,000 francs by selling preserved specimens. This would not cover expenses, and therefore Germany gives an annual subscription of 30,000 marks. To justify this expenditure the Imperial Government has asked me to hand in every year a table of my accounts; and I think it may interest you to see one of them, which I inclose.

Some German and other Governments pay also subscriptions towards the publication of our three periodicals. Thus I am enabled to conduct the whole station in a satisfactory way.

At present I am about to add a new part, viz, a laboratory for comparative experimental and chemical physiology. As soon as that is started I shall try to establish more special arrangements for solving questions relating to fishes and all the problems which the sea offers.

NAPOLI STAZIONE ZOOLOGIA,
Naples, February 10, 1883.

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* This has since been accomplished.—C. W. S.

Financial statement of the Zoological Station at Naples, Italy, April 1, 1882.

	Receipts.		Disbursements.	
	1880–'81.	1881–'82.	1880–'81.	1881–'82.
Aquarium account	$5,974 40	$6,272 70	$882 21	$1,030 54
Library account			758 06	786 93
Export account No. 1 (animals)	1,266 45	2,252 08	748 13	1,347 78
Export account No. 2 (preparations)	252 68	802 95	481 07	360 69
Fishery implements and fauna account			88 55	217 36
Vessels account			1,111 24	546 98
Salary account			9,129 00	9,114 56
General expenses account	124 48	78 63	1,095 32	1,725 74
Laboratory account	106 68	200 93	1,322 13	1,620 29
Machines account			1,169 06	1,127 90
Photographic account			96 29	179 20
Collections account			388 35	94 13
Taxes account			415 02	433 68
Subventions account	11,753 50	7,560 00		
Animal account			1,456 03	1,295 30
Table-rents account	6,940 61	7,454 34		
Interest account			3,402 56	3,258 29
Amortizations account			1,826 90	1,826 90
Publications account	2,882 54	2,775 29	2,936 98	2,671 73
Total	29,301 34	27,396 92	28,206 90	27,638 00
Deducting publications account	2,882 54	2,775 29	2,936 98	2,671 73
	26,418 80	24,621 63	25,269 92	24,966 27

Balance.

	Debit.		Credit.	
	1880–'81.	1881–'82.	1880–'81.	1881–'82.
Zoological Station, cost of station	$90,251 35	$91,277 62		
Cash on hand	184 01	820 05		
Prof. Dr. A. Dohrn, Naples			$60,480 00	$60,480 00
Architect Profurno, Naples			1,200 00	1,200 00
Frau Boutkewitch, Naples			1,111 80	1,220 80
Machinist Petersen, Naples			615 00	618 00
Otto Beer, Naples			16,144 41	9,775 03
Frau Czermack Erben, Leipsic			5,219 00	4,500 00
Dr. C. A. Fiedler, Munich			4,720 00	4,050 00
Prof. Balfour, Cambridge			2,200 00	2,200 00
Werner Siemens, Berlin			1,000 00	1,000 00
Amortizations account			3,745 15	5,759 30
Publications account				1,118 50
Traveling allowance account				176 00
	90,435 36	92,097 67	90,435 36	92,097 67

Deficit 1879–'80	$5,598 21
Surplus 1880–'81	1,094 44
Deficit 1881	4,503 77
Deficit 1881–'82	344 64
Deficit 1882	4,848 41

92.—NOTES ON THE NATURAL HISTORY OF THE BUFFALO.

By HENRY DRESSER.

[From a letter to Prof. S. F. Baird.]

I have lived on the banks of the Illinois River, and among fishermen, for more than thirty years, during which time I have had favorable opportunities for observing the habits of fish.

The buffalo is our great food-producing fish, and supplies food for game fish. In draining and reclaiming lakes and overflowed lands I have often observed their peculiarities. When the streams begin to get warm and are swollen by the rains of spring, the buffalo goes up the creek sloughs and runs to deposit its eggs. These eggs are very small but very great in number, and are deposited near the edge of these waters. The gar follows close behind, depositing its eggs in the same locality. Their eggs are much larger but less numerous. By the time the young buffalo is half an inch long the gar is two inches long and able to swallow the young buffalo. The pike and bass having spawned and hatched their young earlier in the season, have also the start in growth and can devour young buffalo. Thus proceeds the life-struggle—millions of young buffalo hovering close to the water's edge in order to keep out of the way of their devourers.

By November the buffalo that has survived is about 4 inches long; the gar about 10 inches, and the pike from 12 to 16 inches, according to the food supply.

If the buffalo survives until the second year he begins to reach out, and by the autumn is too large to be swallowed by the gar or any but an *old* pike. Two or three years later the buffalo is many times larger than the gar of the same age, and has then nothing to fear except from the fishermen. I have seen them take buffalo that would weigh 30 pounds.

The buffalo commence to spawn when two years old, and enter upon their life work—furnishing food for game fish.

Learning that New England waters have been stocked with black bass by the fish commissions, it occurred to me that it would have been better to have first stocked them with buffalo in order that the bass might have plenty of food. But I am not sure that the buffalo would thrive in that latitude, though I intend making the experiment.

NAPLES, SCOTT COUNTY, ILLINOIS,

January 5, 1883.

93.—FISH CULTURE IN BELGIUM—PROPOSED GOVERNMENT ACTION.*

By E. WILLEQUET.

[From a letter to Prof. S. F. Baird.]

For several months Mr. Lefebvre, United States consul at Ghent, has been the obliging intermediary through whom you have expressed your desire to give to Belgium solid proofs of the kind feelings entertained by the United States and by yourself for our country, by offering to send us a new fish, unknown to European rivers, and which, it is supposed, would be particularly well suited to the comparatively less pure rivers which flow into the basin of the Scheldt, viz, the catfish.

I feel that I must thank you directly for the interest which you take in us; and as the reading of the Annual Reports of the Commission of Fisheries has taught me to appreciate the broad views which you put into practice, I will confess that I still look for other benefits which my country is to reap from your generous proselytism.

I must state right here that I do not possess a single qualification which justifies the liberty which I take in addressing you. My excuse is solely the desire to profit for Belgium from the large amount of work which you have accomplished. I am a member of the Belgian Chamber of Representatives, and my position will perhaps enable me to spread some of your ideas, and cause Belgium to derive some profit from your rich experience. The Government is well disposed. A new law on river-fisheries has been passed, and has just been published with a series of regulations. The Government has also appointed a commission to inquire which would be the best steps for restocking our rivers. I look for good results from the measures which our Government has already taken, and from those which are in course of preparation relative to the river-fisheries. But as regards the sea-fisheries, everything remains to be done.

We possess one fishing-port, Ostende, which supplies a great part of the continent of Europe with fish, and which doubtless in the near future will develop into one of the most important fishing-ports on the west coast of Europe, owing to the railroads from the interior which center here. We also have one important river, which, in its maritime part, shows only very insignificant products of the fisheries. I imagine that if you were placed in similar circumstances, you would have known how to derive considerable profit from our geographical location, and I therefore venture to ask, if your habitual generosity would permit you to give us some practical advice.

If your kindness would induce you to render us some such service, I

* Translated from the French by HERMANN JACOBSON.

am convinced that I could easily induce the Belgian Government to appoint a commission which would follow the line of action indicated by you.

I ask, for instance, if, after the experiments in multiplying codfish which you have made in the port of Gloucester, you would deem it possible to stock the entire North Sea—already rich in fish—to such a degree as to bring the codfish nearer to our coast? At present, our fishermen only catch codfish on the Dagger Bank, a large bank extending from Scarborough to Jutland, and this only in winter. In acting in conjunction with England, could we not succeed in stocking the southern portion of the North Sea with as many fish as fill its central and northern portions? At present, it takes the fishermen two or three days to reach port again on their return from the Dagger Bank.

Am I laboring under a complete illusion in looking for such a result, and is it possible to reach it? Would it be possible to stock the Scheldt with the *Alosa sapidissima*, and the river-herring which you call *alewife?*

But I am only giving you here some few samples of what I have in view. I well know that your ideas on this subject are much more clearly defined than mine. Would it be trespassing too much upon your kindness to believe that you will guide us with your advice?

Mr. A. Lefebvre has assured us that next spring you will send us some catfish. We shall thankfully receive these fish, but we are so ignorant in everything pertaining to them that it would be extremely useful if you would send us some instructions beforehand. In what localities should these fish be placed? In a pond, or in running water? Must some regard be had to the temperature? It would doubtless be useful to place the fish under strict surveillance, so that we can render you a full account of the entire transaction.

CHAMBER OF REPRESENTATIVES,
Ghent, Belgium, February 19, 1883.

REPLY BY PROFESSOR BAIRD.

I will take pleasure in carrying out the original intention of supplying American food-fishes to the waters of the Netherlands. The species that I have considered most suitable is the selfsame catfish, of which your letter makes mention, belonging to the genus *Pimalodus.*

In reply to your query as to the possibility of stocking the shores of Belgium, I am unable to speak without more knowledge of the coast itself. There is no very good reason why a great extension of these may not be accomplished by artificial means. Perhaps it will be better to wait the final results in the United States before entering upon a similar enterprise abroad. I see no reason why the *Alosa sapidissima*, or American shad, and the alewife, may not thrive in your waters. The only difficulty is in carrying them across the ocean. Upon this subject we shall probably make experiments this year, and the results will enable us to advise you.

The catfish which we propose to send are thoroughly hardy fish, and

require no care. It is only necessary to place them in the water, the muddier and more sluggish the better. They will live in ponds or in running streams; and are equally at home in warm water and cold.

WASHINGTON, D. C., *March* 13, 1883.

NOTE.—For other items upon this subject compare Bulletin 1882, p. 153, and Bulletin 1883, p. 218.—C. W. S.

94.—PURCHASE OF PROFESSOR POEY'S ICHTHYOLOGIA CUBANA BY THE SPANISH GOVERNMENT.

By Prof. S. F. BAIRD.

Prof. Felipe Poey, of Havana, under date of the 24th of February, 1883, announces that the Spanish Government has purchased his Ichthyologia Cubana for $4,000. It will be exhibited in the exposition in Amsterdam. He hopes to have it printed in Madrid. The work is in ten volumes, each 450 by 324 millimeters. These volumes contain 1,040 plates of fishes of every period of growth. The drawings were made by himself from life. Many of the plates occupy three and even six double pages. About half fill only one single page each.

The plates represent 758 species of Cuban fishes (1,300 individuals), 90 scales, 94 vertical sections, 87 entire skeletons, 51 half skeletons, 43 details of skeletons, 85 complete visceras, 32 details of visceras, 8 entozoa, and 120 miscellanea.

WASHINGTON, D. C., *March* 1, 1883.

95.—REAPPEARANCE OF YOUNG COD HATCHED BY THE UNITED STATES FISH COMMISSION.

By W. A. WILCOX.

[From a letter to Prof. S. F. Baird.]

The harbor and mouth of the river at and near Portsmouth, N. H., is full of young codfish from four to ten inches long. The fishermen mostly use trawls with quite small hooks and find them in large numbers on the hooks. They take them off with care and return them to the sea. Fishermen say that they have never seen anything like it in the number of very small cod. They give all the credit to the United States Fish Commission, calling them "Professor Baird's fish." Mr. Valentine Doane, jr., of Portsmouth, N. H., can give further information.

BOSTON FISH BUREAU,

Boston, Mass., August 17, 1882.

96.—REPORT ON THE ABNORMAL APPEARANCE OF SHAD EGGS FROM A FISH KEPT IN CONFINEMENT AT HAVRE DE GRACE, MARYLAND.

By JOHN A. RYDER.

[From a letter to Prof. S. F. Baird.]

Mr. F. N. Clark yesterday sent me a shad with roe which was peculiarly affected; it was one of a lot which had been kept in confinement in the "pound" at Havre de Grace. I find the ovarian eggs in large part mature and ready to be emitted, but they present some singular and unusual abnormal appearances. Of these the most striking are the following:

The egg-membrane seems to be slightly fuller than when in the condition usually met with, and the germinal matter is frequently clotted and dead, with a peculiar tendency towards fluidity not to be observed in normal eggs. It seems to me as if the fish in holding the eggs for an abnormally long time had produced the effects noted. My own idea is that it is likely that confining an anadromous fish like the shad we will have just such a result. We know that confinement produces sterility in many animals, and it may be that this is one of the effects of such confinement in this particular instance. Nature will oftentimes revenge herself, so to speak, if too immoderately interfered with. The ripening process seems to have been normal in the ovary, but whether the influence of confinement had something to do with interfering with a perfect maturation of the eggs I am still unable to decide, as my investigations are not yet completed. I have therefore saved some material for this purpose, in the hope that I may get some more data upon this point. The vitellus in the eggs examined by me was much altered from the normal appearance which it ought to present. It looked, indeed, as if the germinal and deutoplasmic or yelk material had suffered admixture. Impregnation of such ova would evidently be out of the question.

WASHINGTON, D. C., *May* 31, 1883.

97.—CATCH OF SPAWNING SHAD IN THE POTOMAC ABOVE GEORGETOWN.

By J. T. LENNURT.

There are being taken daily at this place, by one fisherman on the Virginia side and two on the Maryland side of the Potomac River, from 30 to 40 enormous-bellied shad. The spawn flows freely from them as they come out of the water. A quart could often be taken in the spot where the fish lie on the rocks.

CHAIN BRIDGE, VA., *June* 20, 1883.

98.—SUCCESS OF THE GILL-NET COD-FISHERY ON THE NEW ENGLAND COAST, WINTER OF 1882-'83.

By J. W. COLLINS.

The importance of the introduction, by the United States Fish Commission, of the method of catching codfish by the use of gill-nets, a full account of which was given in the first volume of the Bulletin, has never been so apparent as during the present winter. Owing to the almost total failure of the bait supply it has been impracticable to carry on the shore cod-fishery by the old method of hook-and-line fishing. Such a scarcity of bait has never been known before, and if the fishermen had not been instructed in the use of gill-nets for the capture of cod a valuable and important industry must have been almost abandoned for this season, at least while the scarcity of fresh cod in our markets would have increased the price to such an extent as practically to place this important article of food beyond the reach of the masses.

But during the past two years the New England fishermen have learned a great deal about catching codfish in nets from an illustrated pamphlet containing descriptions of all the methods, which has been freely circulated by the United States Fish Commissioner, Prof. Spencer F. Baird, and to this was also added the knowledge gained in a practical way. They were therefore prepared to meet such an unforeseen emergency as has arisen this winter, and, instead of being compelled to give up the shore cod-fishery, have met with a success which has rarely or never been equaled. Such excellent results have been obtained by the use of gill-nets in the cod fisheries that the local papers in the principal fishing ports have contained frequent notices of successful catches. The Cape Ann Advertiser of December 8, 1882, gives the following account of the "Good results of net cod-fishing."

"On Tuesday, December 4, boat Equal, with two men, took 5,000 pounds of large codfish in seven nets off shore, sharing $40 each. The Rising Star has stocked $1,200 the past fortnight fishing in Ipswich Bay. The Morrill Boy has shared $101 to a man net-fishing off this shore the past three weeks."

The last-mentioned schooner, the Morrill Boy, met with unexampled success, her crew of five men having shared $320 apiece, clear of all expenses, by the last of December, the time employed being less than six weeks.

From the port of Gloucester alone, according to Capt. S. J. Martin, there were employed in the gill-net cod-fishery during December twenty vessels, carrying 124 men and 176 nets. In the period between November 19 and the last of December, 600 000 pounds of large shore codfish were landed in Gloucester, while 150,000 pounds were marketed at Rockport and Portsmouth, making a grand total of 750,000 pounds.

When to this is added the amount which was probably taken by the vessels from Swampscott, Portsmouth, and other ports, it is perhaps safe to say that no less than 2,000,000 pounds of this highly valued and most excellent food-fish were taken by nets during the month of December and the latter part of November. The fish caught in nets have been of extraordinary size, averaging more than 20 pounds each, while some individuals weigh as much as 60 or 75 pounds.*

During the past two winters cod have been taken in nets, with rare exceptions, only in Ipswich Bay, but this season they have been caught very extensively on the rocky shoals in Massachusetts Bay. Since the beginning of January, however, the fish have been most abundant in Ipswich Bay and the fleet of shore cod fishermen have resorted to that locality, where they have met with the most flattering success, the catch during the first month of the year being, it is said, much larger than at any previous time.† The Cape Ann Advertiser of January 26, 1883, contains the following item in relation to this subject:

"The net cod-fishermen are meeting with good success in Ipswich Bay. On Thursday of last week three fares of handsome large cod-fish, nearly 30,000 pounds, were landed at Portsmouth."

An important matter for consideration, in this connection is, that not only can the cod-fishery be successfully carried on even when bait is not obtainable—for, of course, no bait is required when nets are used—but a very great saving is made in time and expense. As an instance of this it may be stated that the average bait-bill of a shore trawler would not be less than $150 to $250 per month, when herring are so high-priced as they have been this winter. Therefore it is safe to estimate that, when such a large fleet is employed in gill netting as there has been this season, the amount saved to the fishermen (which otherwise must be paid for bait) cannot be less than $30,000 to $40,000.

The day is now not far distant when the United States Fish Commission will be able to supplement the many other important works it has done, one of which is bringing about this innovation in the fisheries, by propagating the cod on a very extensive scale, this having been found perfectly practicable. When this is done, we may confidently

* The above statements are based on the report of the Gloucester fisheries for November and December, by Capt. Stephen J. Martin, of the United States Fish Commission, pp. 159–161 of this volume.

† According to Captain Martin's report for January, 1883, 121,000 pounds of cod that were caught in gill-nets were landed in Gloucester during the month. (See page 168 of this volume.) Writing to Professor Baird, under date of February 6, 1883 (see page 160 of this volume), he makes the statement that ten sail of small vessels, which had been fishing in Ipswich Bay, had landed at Rockport, Mass., and Portsmouth, N. H., during the previous twenty days, 230,000 pounds of large codfish. Calculating on this basis, the total catch of the whole fleet during the month of January would be very large. Owing to the fact, however, that no accurate and reliable statistics of the entire catch in gill-nets, along the whole coast, is obtainable, estimates must be based on the reports of the Gloucester fisheries, which have been carefully made by Captain Martin.

look forward to the establishment along our coast, from Eastern Maine to Virginia, of a cod-fishery unexcelled in any part of the world, and which for ages to come will be a fruitful source of food supply for the millions who people our land.

WASHINGTON, D. C., *March* 1, 1883.

99.—A MAMMOTH COD.

By EVERETT SMITH.

The largest specimen of the common Atlantic coast codfish (*Gadus morrhua*) I have seen was displayed at the market in this city April 11, 1883. It was caught by a boat fisherman off Wood Island, about 12 miles from Portland, April 9. I noted the following measurements: Length (central), 65 inches; length of head (opercular flap), 17.5 inches; girth of head, 32 inches; weight, 100 pounds.

PORTLAND, ME.

100.—ARRIVAL OF BLUE CARP FROM GERMANY.

By RUD. HESSEL.

[Report to Prof. S. F. Baird.]

We have received from Mr. E. G. Blackford, of New York, by four separate shipments during the last five weeks, eleven new carp, so-called blue carp, sent from Germany. There proved to be eight blue leather carp, one common leather carp, one common mirror carp, and one common scale carp.

Two of the blue carp were dead when received here and two others died two days after. Another, the scale carp, died to-day. We have now six in all; four blue leather, one common leather, and one common mirror carp. The fish were all in a very bad condition from the transport on the sea, suffering from fungus and new bruises they had gotten in the small tanks at New York, which seems to have been too small for that size of fish. They were covered with numerous parasites; *Branchiobdella astaci*, which lives upon grown fish, and *Piscicalo geometro*.

The carp are suffering yet. Morbid as they are, they can scarcely digest the light food they are getting every day—cooked flour with raw eggs. They had not gotten any food in New York although they were kept there some days.

I am using the utmost possible means to save them, but I cannot positively promise their recovery.

WASHINGTON, D. C., *February* 9, 1883.

101.—ABILITY OF CARP TO ENDURE MUDDY, SLIMY, AND STAGNANT WATER.*

By C. M. WHITE.

I received from the United States Fish Commission, Washington, D. C., twenty German carp during the month of February, 1883. The fish were from 1½ to 2 inches long, and having been unavoidably detained in making a permanent pond, I made a temporary dam across the stream, above where I intended to make my permanent dam. I put the fish in that temporary pond. A few days before the permanent dam was finished a heavy rain caused an overflow, and, as I then thought, carried off all my fish into a large stream into which the smaller stream emptied just below the dam. The stream upon which was the dam being a wet-weather stream (one that went dry during the summer), I arranged to supply water to the pond by pipes from my mill-race. Thinking the carp had been washed out, I completed the dam, but did not conduct the water there; this was during the latter part of April, 1883. Thus matters stood. The water in the stream ceased to run. A green scum formed thickly over the stagnant water, and instead of a fish-pond I had a first-class frog-pond. A dry summer following, the water in this temporary pond got so low that some twelve or fifteen hogs running into the adjoining field made it a place for wallowing daily in the soft mud. The pond became veritably a mud-puddle, some five or six yards long and one to three yards wide. The hogs continued to wallow and the water to lessen, until it got so shallow that my father, being at the pond or mud-puddle, one Sunday morning, saw what he thought was the back-fin of a fish above the muck. We at once investigated, and by the use of a perforated tin took from this mess, to our great astonishment, six German carp. The largest was 14 inches long, as thick as a man's wrist, and as wide as the palm of the hand. The others were about 10 inches long and proportionally heavy. I put them in fresh water until I could fix the pipes to conduct water from the race to the pond, but unfortunately the largest carp died, I think from a fall in leaping from the bucket and falling on the hard ground. The five lived, and I have them now in my pond well supplied with fresh water from the mill-race. At the time these fish were taken from the "hog-wallow" there had been no fresh water entering it in any way for six weeks, nor had any food whatever been given the fish. Now my carp are as lively as kittens, and keep the water well stirred up in nosing around.

WARRENTON, VA., *October* 13, 1883.

* This statement, being considered extraordinary, was sworn to before R. H. Downman, clerk of Fauquier county court, who also vouches for Mr. White.—C. W. S.

102.—PROPOSED LIMITATION OF THE HERRING FISHERY IN MAINE, AND ITS EFFECTS UPON BAIT AND CANNING INTERESTS.

By R. E. EARLL.

[From a letter to Prof. S. F. Baird.]

Permit me to call your attention to the following extract from a letter which I have received from Mr. Henry S. Menann, dated New York City, January 24, 1883. He says:

"There is a movement on foot at present to induce the legislature of Maine to pass a law to limit the canning of herring to eight months in the year, so that factories will be closed from December 15 to April 15. I have often expressed the wish to have such a law enacted, and am very glad that steps are being taken to secure it. General T. D. Leavitt, of Eastport, has the matter in hand. The reasons why the law should be passed may be briefly summed up as follows:

"1. The quality of the fish in the winter months is too poor for canning purposes.

"2. The fish are mostly brought in in bad condition.

"3. Half of the fish are too small and are turned into pomace.

"4. It would stop the driving of herring, which is a very destructive practice.

"5. The winter months are not suited for canning fish successfully.

"6. The demand for canned fish is very light in winter, and as there is usually an overstock on the markets in December the attempts of greedy packers to pack fish in the winter months keeps the markets in a feverish state.

"7. The packing of poor quality fish badly hurts the industry.

"8. Nature herself opposes the taking of these fish in the winter by increasing the difficulties of their catch.

"9. Only greedy packers will undertake to pack in winter; honorable parties in the business close their factories invariably in December and do not start up until latter part of April.

"10. To pack herring eight months in the year is entirely sufficient to supply the markets and then have an overstock.

"I think these are all good reasons why the law should be enacted, and I have no doubt that you will so consider them."

The bait question is not affected in the least by the proposed legislation. Fully 95 per cent. of all the herring taken for bait during the winter months are caught in nets. Those taken in weirs at this season are usually too small to be sold to the "frozen-herring-dealers."

But, further, the law will not prevent the fishing of weirs, and any of those who may be anxious to secure bait for shore fishing can still visit them and seine out as many as may be needed, leaving the remainder to escape at high water. If the weirs are not fished (and if

the sardine canneries are closed, it will seldom be found desirable to fish them) the gates can be left open and the fish can escape as easily as they enter.

The principal point in favor of the proposed law is, I think, found in the fact that the small herring are very poor during the winter months, and those canned at that time, being of inferior quality, seriously injure the reputation of American sardines. If the Maine canners would buy only good fish and pack them in better oil the prejudice against "herring sardines" would soon wholly disappear, and the demand for them would be greatly increased.

WASHINGTON, D. C., *January* 30, 1883.

103.—SHAD WORK IN SOUTH CAROLINA.

By C. J. HUSKE.

[From a letter to Prof. S. F. Baird.]

In March our attention was directed to the shad station on the Edisto River. Last season we constructed a rough frame building at the base of a small pond fed by springs from the neighboring hills. The tin hatching cones were fed by surface water at an elevation of 10 feet. This season we added two glass hatching jars, thus making the capacity 2,000,000 per week.

Shad fishing begins on the Edisto River early in January and continues until the first of April. Between 35 and 40 gill-nets are employed in a distance of 8 miles and just within tide water. They average to catch 350 fish per net. Shad fishing is done between the night tides and mostly after midnight. During the day the water is so very clear as to render gill-nets unavailing.

We rarely, if ever, find ripe eggs. A large number of shad were handled in a half-ripe condition. The eggs when forced came in clots. A large per cent. were apparently ripe and were impregnated on coming in contact with the milt. The greater number, however, had no appearance of being ripe, were small, hard, and perfectly white. We succeeded in obtaining a small number of eggs and planted 440,000 fry in the Edisto. I visited the Savannah River at Augusta and the North Fork of the Edisto River during the month of April, and found the catch very small. The 500,000 fry which I procured from you in May were planted in Broad River at the Atlanta and Charlotte Air Line Railroad crossing. These were in fine condition when released, the loss in transportation not exceeding 3,000. Active operations in this State have been going on for so short a time that the results are as yet comparatively small, but the enthusiasm of our citizens is widespread.

COLUMBIA, S. C., *June* 1, 1882.

104.—PERIOD OF INCUBATION OF EGGS OF GERMAN CARP.

By H. H. CARY, M. D.

[From a letter to Prof. S. F. Baird.]

I have been taking some pains for the past two years to ascertain the period of incubation of the eggs of German carp. A statement in your report for 1875-'76 that they hatched in from twelve to sixteen days was doubtless based on a lower temperature of water than prevails in this latitude during the hatching season. Last year, with the temperature of the water at about 69° the eggs hatched in about five to six days. The present year, with a higher temperature of water, a more carefully conducted experiment has demonstrated that the eggs will hatch in from forty-eight to seventy-two hours. The eggs hatch finely in water at a temperature of 90°.

LA GRANGE, GA., *October* 21, 1883.

105.—SUCCESS OF THE UNITED STATES EXHIBIT AT THE LONDON INTERNATIONAL FISHERIES EXHIBITION.

By JAMES RUSSELL LOWELL.

[Dispatch No. 552, to Hon. Fred'k T. Frelinghuysen, Secretary of State.]

I have the honor to report that the International Fisheries Exhibition promises to be far more successful than even the most sanguine of its projectors had ventured to hope. The wisdom of Congress in making so liberal an appropriation in furtherance of its object is entirely justified both by the substantial encouragement given to the enterprise at its inception by this proof of interest on the part of the United States, and by the fact that the section devoted to our country is more valuable than that of any other, and valuable for reasons of which we may very properly be proud.

I have the highest authority for saying that, quite apart from any consideration of intrinsic interest or curiosity, our share in the Exhibition is superior to all others in virtue of the scientific intelligence shown n its arrangement and classification, thus rendering it more instructive than any other. This is especially gratifying because it is a triumph of a far higher kind than could be won by any ingenuity in our contrivances for the breeding or mechanical perfection in our implements for the taking of fish, though in these also we may safely challenge and in some cases defy comparison.

The credit of this unquestioned success is due undoubtedly in the first place to Professor Baird, whose absence is universally regretted,

but hardly less to the intelligence, zeal, and untiring energy of Professor Goode and his assistants, who literally worked night and day in order to be ready for the day fixed for the opening of the Exhibition.

I shall naturally have occasion to write again and more fully on this topic when more perfectly informed, but could not deny myself the pleasure of reporting to you the impression already made in this international competition by the genius for organization of which our countrymen have here given proof, a faculty certainly not the lowest among those that distinguish the social and civilized man.

LEGATION OF THE UNITED STATES,
London, May 19, 1883.

106.—A NEW FISH-HATCHING APPARATUS.

By von LA VALETTE ST. GEORGE.*

[From a letter to Prof. S. F. Baird.]

The hatching apparatus which, at my request, was sent to you by the Prorector of the Anatomical Institute, Professor Nussbaum, was invented by me and has been described in the Record of Microscopic Anatomy, Vol. XXI.†

The apparatus is intended for the breeding of *Salmonidæ*, and principally for small hatcheries and for the owners of ponds and creeks who have any running water and desire to have them stocked with young *Salmonidæ*. The operation of the same is quite simple. After the two troughs have beeen put one into the other, the impregnated eggs, to the number of 5,000, are placed on the wire bottom of the inside trough, and the opening of the receiving pipe on the outside trough is put under a stream of water. Through this pipe the water flows in and must circulate around the eggs from below. Passing through the wire on the sides of the inside trough, it is discharged on the opposite side of the entrance. The opening for the outlet of the water being higher than the sides of the wire openings prevents the young fish from floating against them. A sieve in front of this construction is quite unnecessary.

In Germany many hundreds of this apparatus are in use. They are practicable and are much praised. For the purpose of encouraging the distribution of the apparatus I have not had it patented.

BONN, *January* 31, 1883.

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*Director of the Anatomical Institute at the University of Bonn, and president of the *Rheinischer Fischerei-Verein.*

†*Archiv fur Mikroskopische Anatomie, Band XXI.* See also page 209 of this volume.—C. W. S.

Vol. III, No. 29. Washington, D. C. Dec. 7, 1883.

107.—NOTES ON THE MODEL OF THE GULF OF MAINE CONSTRUCTED FOR THE UNITED STATES FISH COMMISSION.

By A. LINDENKOHL.

MODEL MADE FOR THE FISH COMMISSION.—A model of the Gulf of Maine was constructed for the United States Fish Commission, in order to exhibit clearly the geological construction of this part of the Atlantic; this construction being of such an intricate nature that it cannot be discerned with the distinctness and minuteness desirable from hydrographic charts.

Such charts, in general, are not the best medium to convey exact conceptions of shapes of bottom for the reason that figures are employed to denote depths instead of contour lines, and also for the more important reason that there will always exist anomalies and deficiencies upon such charts owing to imperfect methods of surveying.

If soundings would furnish us a correct idea of the bottom, the production of a faithful model would be a mere question of mechanical skill; but it is a matter of fact that whenever there is great irregularity in the form of the bottom soundings only furnish indications of its shape, and it requires considerable geological knowledge and familiarity with the various molds employed by nature under given circumstances in order to obtain an intelligible representation of the bottom.

Holding these views, I think it incumbent upon me to submit a resumé of the results arrived at whilst engaged upon the model of the Gulf of Maine, in order that those who are able to judge may determine to what extent nature has been properly interpreted.

BOUNDARIES OF THE GULF OF MAINE.—The term "Gulf of Maine" was first employed by the United States Coast Survey to designate that part of the Atlantic which lies between the eastern coast of the New England States and Nova Scotia, to the northward of a line from Nantucket to Cape Sable, and which connects with the Bay of Fundy towards the northeast.

NANTUCKET SHOALS.—The Nantucket Shoals comprise a series of narrow bands of shoal ground off the island of Nantucket, reaching out in a southeast direction about forty miles. Besides ascertaining their positions, the Coast Survey has developed the fact that the shape of the shoals conforms in a remarkable degree to the directions of the tidal currents. The flood current sets in from the southwest and the ebb current from the northeast, both moving over the same ground in reversed directions, which coincide with the major axes of the shoals.

Tidal currents have not only given shape to the shoals but have also abraded the island to a considerable extent. Nantucket Island consists of sand and other drift material loosely piled up; consequently the

highest elevation should be found about the middle of the island. In fact, however, this elevation, about 100 feet, is found at Sankaty Head, its most projecting point, and hence we conclude that in former times the island has extended over a part of the ground now occupied by the shoals. The southern coast of the island, that west of Sankaty Head, has received its shape from the flood current, whilst the west coast, or that north of Sankaty Head, has been formed by the ebb current.

GEORGE'S BANK.—The existence of this bank must have been known to the earliest navigators; it was originally called Malebarre Bank, but has borne its present name since about 1700. The total absence of cretaceous and tertiary deposits from the eastern coast of Massachusetts and the coast of New Hampshire leads Professor Hitchcock to the conclusion that during those ages these coasts must have occupied a higher level than at present; hence it is possible that a greater or lesser part of George's Shoal may once have been dry land. However that might have been, there is not the least doubt from an examination of the surface deposit that the bank owes its present shape and height to a thick layer of drift material belonging to the glacial period. Indeed, it is not possible to suppose that masses of ice, many thousands of feet in height, would have finally melted before coming into contact with the warm waters of the Gulf Stream off the southern edge of George's Bank. Hence we may consider this bank as the terminal moraine of the glaciers belonging to the glacial period and subsequent to it. Between this bank and the coast of Maine there exists a relation very similar to that between the southern and northern shores of the Great Lakes, and it would require an elevation of less than 1,000 feet to convert the Gulf of Maine into an inland sea.

The shoalest parts of this bank, George's Shoal and Cultivator Shoal, have less than three fathoms and must be considered dangerous to navigation. From the fact that these shoals conform in their directions to the tidal currents which run across the bank at nearly a right angle to its general stretch, and maintain their shape and position in spite of their exposed location, we are justified in considering them as the permanent result of tidal action.

CAPE COD.—Cape Cod is an immense heap of drift material. Its topographical configuration alone shows that, like Nantucket, it has received great abrasion on its eastern side. The greatest height, about 200 feet, exists at the Highlands—the most exposed position, where there has been the greatest wear. The tidal currents, which in this abrasion process we must consider the most persistent if not the most active, run parallel to the coast, the flood from the south and the ebb from the north.

STILLWAGEN'S BANK.—This shoal, discovered by the Coast Survey in 1854, lies across the entrance of Massachusetts Bay in a line from Cape Cod to Cape Ann. There is very little doubt in my mind that this bank belongs to the same geological formation as Cape Cod; that it formerly was probably much shoaler and directly continuous to Cape

Cod. It cannot be assumed to be a fold of strata on the Appalachian system, because these strata have a southwest and northeast direction. A look at the map of Cape Cod shows that this coast is subjected to the visitations of powerful northwest and northeast winds, which roll up sand dunes a hundred feet high. If we furthermore mention the circumstance that the tidal currents which run into and out of Massachusetts Bay make right across the bank, we have named two agents which work at its destruction. Its existence in its present shape and depth of about 10 fathoms as a submarine bank is largely due to the protection afforded by Cape Ann and Jeffrey's Ledge on the northward and by Cape Cod on the southward.

THE MASSACHUSETTS COAST.—The coast of Massachusetts assumes a distinctly rocky appearance about Scituate and maintains this character to beyond Cape Ann. According to Professor Hitchcock (Smiths Cont., Vol. IX), Boston Harbor has been scooped out of softer metamorphic slates by the action of tides and breakers, whilst these agents had no perceptible influence upon the unyielding syenite of Cape Ann and Cohasset.

JEFFREY'S LEDGE.—Jeffrey's Ledge, off the coast of New Hampshire, lies in direct continuation of Cape Ann, and extends in a direction parallel to the ranges of hills composing the cape. This ledge presents a very different appearance from the banks heretofore considered; it is much bolder, and instead of a large and nearly level surface, as possessed by George's Bank and Stillwagen's Bank, it shows a narrow ridge, rapidly falling off east and west into depths of over one hundred fathoms. This shape points to subterranean upheaval as the cause of its formation, and we conclude that it is the continuation of Cape Ann and identical with it in its geological structure; that its body consists of granite and syenite. The difference in level, Cape Ann being about 250 feet above and the ledge 90 feet below the ocean, is inconsiderable in a geological view. It is a characteristic feature of this one and nearly all the other ledges in the Gulf of Maine that their surface is covered by a fine sand, which changes into a coarser sand and gravel on their sides, which in turn are lost under a thick covering of mud when we get into the deeper parts of the gulf.

THE NEW HAMPSHIRE COAST.—Between Cape Ann and Hampton River we meet alluvial deposits, but thence to beyond the limits of New Hampshire, to Cape Small, in Maine, we find stratified rocks, which may be designated as metamorphic slates (principally mica schist) with numerous irruptions of granite and trap. Cape Elizabeth and the islands in Casco Bay belong to this formation. According to the soundings it extends a considerable distance into the sea and includes the Isles of Shoals, Boon Island, and the ledges off Portland Harbor. The strike of the strata is uniformly northeast, and the peculiar tendency of this region is the formation of low and parallel ridges of hills and islands above the water and of submarine rocky ledges running northeast. Cape Eliza-

beth rises to about 150 feet, and at about an equal depth, 25 fathoms, the traces of this formation are lost in the ocean.

THE COAST OF MAINE.—From Portland to Eastport the coast of Maine has that characteristic appearance which we only find in the coast line of high latitudes on both continents, which we attribute to attrition by ice and call the *fiord* formation. Fiords are essentially a succession of narrow channels, seldom exceeding one or two miles in width, with parallel sides and running in approximately parallel directions. These channels are generally separated by equally narrow peninsulas or ranges of islands. The inclination to parallelism is, in general, sufficiently pronounced to enable us to detect these regions by a mere inspection of the charts.

Assuming with Professor Dana, and the late Prof. Louis Agassiz, that these fiords have been excavated above the level of the sea by the grinding action of bases of glaciers, we find that the coast of Maine must have stood about 50 fathoms above its present level when its fiords were being shaped, since they extend to about that depth below the present level of the sea. In many places we find this depth exceeded, notably in the case of important channels. In the channel of Penobscot Bay we have depths of 83 fathoms; but we can account for these contradictions without casting loose from the glacier theory by making allowance for the weight of a glacier making itself felt to some distance into the sea and by assuming the occurrence of gorges in the defiles of long channels.

In studying the effects of glacial action upon the configuration of the coast of Maine we have to draw a distinction between the movements of large continuous masses of ice in a uniform direction independent of the shape of the ground and the motion of local glaciers dependent upon the shape of the ground. To the former we must ascribe the striæ in the rocks about Portland and elsewhere, the general shape of the islands off the coast and of the hills and mountains along the coast, and also the more important river channels. Most probably there was a gradual transition from the great "continental glacier" to local glaciers, and the work commenced by the former received its finishing touches by the latter.

The prevailing directions of the striæ and fiords on the coast of Maine are south and south-southeast. Portland Harbor is a fiord channel, cut out of the slate strata of Cape Elizabeth, at an angle of about 60° to the strike of the rocks. East of the White Mountains, ranging in height from 4,500 to 6,300 feet, the most conspicuous elevations on the coast are the Camden Hills, about 1,300 feet high, and Mount Desert Island, 1,532 feet. Midway between the Camden Hills and Mount Desert we have Isle au Haut, 556 feet high. These hills must have offered considerable resistance to the ice coming from the northward, and hence we find the strongest traces of glacial action in the vicinity of Penobscot Bay and Mount Desert Island.

MOUNT DESERT ROCK.—This rock occupies the most isolated and

most exposed position of any island on the coast of Maine. Its preservation through the glacial period must be ascribed partly to the hardness of its mineral composition, and partly to its position in the rear of Mount Desert Island, with which it is connected by a ridge, at a depth of about 80 fathoms.

GRAND MANAN ISLAND.—This island, which rises to the height of about 400 feet, lies in the middle of the entrance to the Bay of Fundy. It belongs, politically, to the Province of New Brunswick, but, in its topographical and geological structure, it resembles more closely Maine, from which it is separated by a channel of rather less than 40 fathoms. It even appears probable that, during the earlier parts of the glacial period, this island formed a part of the coast of Maine.

CASHE'S LEDGE.—Cashe's Ledge is a rock with 5 fathoms of water on it. Situated near the middle of the gulf, it constitutes the only danger in the deeper waters of the gulf, and inside of George's Bank. Cashe's Ledge and Ammen's Rock are identical, although two rocks are indicated on the Coast Survey charts. This doubling a single rock is owing to uncertainty of position, and is in accordance with the maxim that it is safer, in cases of doubt, to give one more rock than really exists, rather than omit one. Cashe's Ledge forms the crest of the middle one of three submarine ridges, which probably consist of granite and show, by their shapes, that they have been subjected to strong glacial abrasion. It is not improbable that these rocks may have been above water in antediluvial times.

PLATT'S BANK.—The existence of this bank was known to fishermen before its discovery and survey by Captain Platt, of the Coast Survey It is situated upon the same rocky plateau with Cashe's Ledge, Jeffrey's Bank, and the Fippennies. It has 29 fathoms' depth, whilst Jeffrey's Bank and the Fippennies, the existence of which has been generally known much longer, have a depth of 46 and 39 fathoms, respectively. None of these ledges have much importance, either to navigation or as fishing grounds, and their shapes have not been as well determined, by survey, as the ledges previously mentioned. Hence we will not venture upon any hypothesis regarding their geological structure, beyond the statement that they must be composed of some hard material, since they occupy positions where they must have been subjected to strong glacial abrasion.

GULF OF MAINE—GENERAL DISCUSSION.—We may fairly assume the whole of the Gulf of Maine, from the foot of the fiords to George's Bank, to be strewed over with bowlders, and the *débris* of melted glaciers and icebergs; but all this, in the deeper parts of the gulf, is hidden under a heavy layer of mud. The greatest depth in the gulf is about 180 fathoms, and this depth is reached in both basins, the one to the eastward and the one to the westward of Cashe's Ledge. This depth is rather insignificant, when compared with the depths outside of the banks, where, at a distance of only 20 miles, 1,500 fathoms are rached.

The main part of the gulf has a flat bottom, ranging in depth from about 90 to 180 fathoms. In its shoaler parts, at a depth of about 100 fathoms, there are indications of flat ridges, which attach themselves to rocks and ledges, and stretch in the direction of prevailing currents.

At a depth of 40 fathoms George's Bank is united with Nantucket Shoals, and this vast bank, which lies across the entrance to the gulf, is almost continuous to Sable Island Bank. The separating channel is only about 140 fathoms deep and 20 miles wide; at a depth of 500 fathoms every trace of it disappears.

The existence of elevated sea beaches, around the Gulf of Maine, goes to prove that, at a time subsequent to the glacial period, when the river valleys in New England were filled with water to their very tops, at the time of the "Champlain Period," the shores of the gulf had subsided, at Sankaty Head, 85 feet; at the coast of Maine, in some parts, 217 feet; about the Bay of Fundy, 350 to 400 feet (Dana's Manual of Geology). In consequence of this subsidence, the waters of the Saint Lawrence must have had free access to the Gulf of Maine, since the separating isthmus is only about 20 feet above high water. Great quantities of floating ice must have passed through the Bay of Fundy, and the steepness of the banks of the channels, on both sides of Grand Manan Island, bears evidence of powerful abrasion from the direction of the Bay of Fundy.

The effect of a boreal current upon the fauna and upon the climate of the Gulf of Maine is a very tempting subject for inquiry, but it is beyond the scope of the present article.

In Passamaquoddy Bay, about Eastport, we find very marked fiord indications running southeast, and again, others nearly as well developed, bearing west of south. According to the views heretofore expressed, the first are contemporary in formation with similar marks found along the whole coast, and belong to the earlier part of the glacial period, whilst the southwest marks belong to a later part and are of a more local character.

WASHINGTON, D. C., *December* 26, 1882.

108.—REPORT UPON HATCHING ONE MILLION WHITEFISH EGGS FROM THE GREAT LAKES AT ORLAND, ME., AND UPON PLANTING THE YOUNG IN EAGLE LAKE, MOUNT DESERT.

By H. H. BUCK.

The eggs came on Monday, February 26, in one case, which was large and heavy and not provided with handles, so that it was rather weak when it arrived. The eggs were immediately taken out and found to be cool. The temperature of the moss was below 35°, but a small per-

centage had hatched and died, so that the package smelled "fishy." They were washed and put into water at 34°, and a few of them hatched within twenty-four hours.

I considered it desirable to keep them at the hatchery, if possible, until the ice should be out of Eagle Lake and the steamers running to Mount Desert. So I continued until April 19 the use of the coldest water at command, which was below 34°. Upon that day the eggs were about half hatched, and I took one 20-gallon can of young fry and went to Mount Desert to make arrangements for the reception of the whole number. I left the hatchery at 6 a. m. and arrived at the lake at 10 p. m. I found it beginning to thaw out around the shores, and turned in the fish all in good order.

From the 19th to the 26th of April the temperature of the water rose to 37° and the rest of the eggs hatched.

On the 26th, at 7 a. m., we started with all the fry in fourteen tin cans, and four small casks which had received two coats of shellac upon the inside and were provided with perforated covers. We arrived at the lake at 9 p. m. The fish in the cans were in good condition, but we lost all that were put in the casks. I had no way of ascertaining definitely any of the losses, but up to the time of transportation they were small. I judge that of the 1,000,000 which left Michigan something over 700,000 were turned into Eagle Lake in good condition.

The fry taken down upon the 19th were liberated upon the north side of the lake, about one-fourth of a mile westward from the outlet. Those liberated upon the 26th were taken up the eastern shore in boats as far as the ice permitted and scattered along shore as much as practicable, most of them from one-half to three-fourths of a mile from the outlet, and all upon rocky bottom.

PORTLAND, ME., *June* 4, 1883.

109.—EXPERIENCE OF A MENHADEN-OIL MANUFACTURER IN NORTHUMBERLAND COUNTY, VIRGINIA.

By WILLIAM R. POLK.

[From a letter to Prof. S. F. Baird.]

For the past three years I have been engaged in fishing for menhaden to make into oil and guano or scrap. Last season I had at this place seven sailing gears, and one steamer fishing in the Chesapeake Bay and Atlantic Ocean.

I had my steamer, the J. W. French, seized by the authorities of Elizabeth City County, Virginia, while fishing last July in the Chesapeake, although it had a United States fishing license. It was a few miles inside the capes, but several miles south of that county, and in the waters of Princess Anne County. At the trial the judge confiscated steamer and nets, and I have appealed to the United States courts.

FAIRPORT, VA., *October* 12, 1882.

110.—THE INCIPIENCY OF THE MENHADEN OIL BUSINESS.

By E. L. BARKER.

[From letter to Prof. S. F. Baird.]

I passed my youth in daily contact with those who constituted more than one-half of all the "menhaden fishers" of that day. My grandfather was the originator of the net then and now in use, and was the first to discover, to "try out," to market, and to give value to this most valuable product. I have made from this fish, selected and properly cooked as the "staff" of the meal, more enjoyable breakfasts while yet a boy than ever since from "A 1" mackerel. I have seen my father and nine others realize $440 cash for a few hours' work in seining, and this at a single catch. This was years before the use of steam in the business. I sincerely wish it were in my power to throw a little light on any recent changes, real or alleged, in their habits, in their migrations, as well as upon their relations to what are known as edible fish.

WASHINGTON, D. C., *December* 28, 1882.

111.—REASONS FOR RESTRICTING THE USE OF STEAMERS AND SEINES IN THE MENHADEN FISHERY.

By LOUIS C. d'HOMERGUE.

[From a letter to Prof. S. F. Baird.]

I have received, through the courtesy of a friend, a copy of the testimony taken by the subcommittee on Foreign Relations, "to examine into the subject of the protection to be given by law to the fish and fisheries on the Atlantic coast."

It seems to me that the questions were so put as to procure admissions on the part of the menhaden fishermen that they caught large quantities of food-fish in their nets, and that owing to the rapidity with which they were bailed into the vessels it would be impossible to detect them. This, of course, is a wrong impression, for other fish are so distinct that they are detected as easily as a lump of chalk would be in a load of soft, fine coal. The fact, however, has been clearly established by all the witnesses examined in the interest of the menhaden steamers that they do not catch enough food fish to furnish diet for their crews, and that whenever this rule is broken by an exception the food-fish is brought to market for sale. But the truth is that the market is soon glutted, so that what remained on two occasions had either to be thrown overboard or turned into guano which went to make food.

Tons of food-fish are removed weekly from Fulton market, in summer especially, and taken by two well known fertilizing firms.

I cannot understand why the superintendents of markets were not examined on this point. Then again, the questions were well chosen to gain the admittance that menhaden could be caught as well two or more miles offshore as inshore, and with nets of 3-inch meshes.

The answers to these questions, given as they were, by men of practical experience, who had not seen each other, and who did not know the object of the questions put or their purport, fully gave the negative to the position it seems had been assumed, that the menhaden fishing could be carried on at a distance of 2 miles from shore, and with nets of 3-inch meshes, with no ill effect upon the result; also that the season should not commence till July 1.

I am much pleased that the chairman, Senator Lapham, put his questions so shrewdly as to get at the truth of the matter.

Now, on the part of the market or food fishermen, their testimony amounted only to surmises. In answer to questions they either assume certain things or admit that they know nothing about the question at issue. Captain Wilcox very aptly put it when he said, "There are times when there is a little scarcity of food-fish, and they will turn right around and attribute it to the first thing that comes into their minds."

Mr. Eugene G. Blackford reduces all of his testimony down to one point in regard to legislative action, which, in his own language, sums up the question as follows: "But from my experience in regard to all fish, and protection of fish, there is no doubt but the protection of the fish during the spawning-season would give greater results and be most effective."

Now, in view of this opinion, take a previous answer of his to the question when the menhaden spawned. He answered, "The exact time, the exact localities of spawning are not determined."

If such is the case, when can legislative action be applied to the time of menhaden spawning? And why should from April to July be a close season any more than from July to November? The fact is that there are more than one reason accounting for the scarcity, abundance, or entire disappearance of fish, and that the prime causes of their absence or presence, besides food, lie in the conditions of weather, density and temperature of water. New York Harbor is becoming rapidly destroyed by garbage, its waters defiled with waste products of manufactories; these combined have a tendency to make all fish scarce in the waters adjoining New York.

Some of our menhaden people are running a little wild on the question of menhaden remaining in one locality according to the quality and quantity of their food. Mr. Friedlaender argues that the fatness of the fish caught off the capes of the Delaware would prove this, and mentions that my catches off Long Island were not so fat as those further south. In this he is mistaken, as careful inquiries developed the fact that there has been no appreciable difference in the fat-producing qualities of the fish caught between Narragansett and Delaware Bays.

It seems to be absurd that for the assumed preservation of two fish which are considered dainties, viz, bluefish and bass, all this ado is made. If the committee had secured the statistics of all the food-fish received for the last ten years in New York, Boston, Baltimore, and Philadelphia markets, I feel confident that they would have found the quantities had largely increased to meet the increased demand. The food-fish forming the main fish diet of the masses of the people, such as cod, herring, mackerel, porgies, flounders, eels, halibut, shad, and numerous others, do not require the menhaden either as food or bait, yet they all have their occasions of periodical scarcity, and had even when menhaden fishing was unknown.

But I am one of those who believe in certain restrictions as to the mode of conducting the business. Not that the catching of menhaden in any way interferes with the supply of game or food fish, or that their catching by man diminishes their numbers to any appreciable degree; but that the manner in which they have of late been pursued has had, in my opinion, a tendency, with other causes, to keep them from following, what seems to be, their natural method of migrating up and down the coast. For these reasons, my observations have led me to the opinion that the Atlantic coast should be divided off into districts, say from the Gulf to Cape Hatteras, from Cape Hatteras to Chesapeake Bay, from Chesapeake Bay to Delaware Bay, from Delaware Bay to Fire Island, from Fire Island to Cape Cod, Long Island Sound to Point Judith, and from Cape Cod to Maine, &c.; that fishing for menhaden should not commence until the 1st of June, to allow the fish to school along the coast; that not less than 2½-inch meshes be used; that fishing licenses should be required for each and every vessel for the district it was to fish in; that said vessels should not be allowed to fish in districts except those for which licenses were granted, and before changing a district, the license would have to be surrendered and replaced by a new one for the new district before fish could be caught therein. By these means the fish would have a chance to school; young fish would not be caught, the fishing fleet would be scattered so as not to be concentrated at any one given point at a moment's notice, thereby preventing an even distribution of the fish along the coast. I know that some short-sighted people or some over eager for gain will strongly denounce this, but all I claim for the above is that it is the result of most deliberate consideration and the basis of my honest convictions that such a plan would benefit all concerned and reconcile opposition.

I notice the report of the steamer Fish Hawk meeting large bodies of menhaden off-shore; this circumstance may be used as an argument to the effect that steamers united with natural enemies and causes drove them off.

Recent occurrences have made me return to my first opinion, viz, that there should be legal and proper restraints over this class of fishery.

47 WILLOW STREET, BROOKLYN, *October* 14, 1882.

112.—NOTES ON THE MENHADEN FISHERY.

By OSCAR O. FRIEDLAENDER.

[From letters to Prof. S. F. Baird.]

1882.

The catch of menhaden this year is about 20 per cent. smaller than last year. This is not on account of a scarcity of fish, but of the distance the steamers have to go for them. The great resort for menhaden this year is between Barnegat and the Delaware Breakwater. Just now they are at the latter place, and I think there must be an abundance of food there, especially as I have never, since entering the business, seen such fat menhaden as those caught this summer. Last year the average yield of oil was about 2 gallons to a thousand fish; this year it is between 5 and 6 gallons. Captain Powers, of the steamer De Blois, tells me that he never saw such a sight of fish before as he saw last Saturday about 5 miles below the Delaware Breakwater.

Our catch this season is thus far 19,305,000, with more steamers than last year, when we took 17,069,000. Last week I went out on one of the steamers to gather information. The sight of little fish was something extraordinary. For 50 miles along the Jersey coast there was one solid body of fish, which cannot be estimated by numbers; but if they all were to grow up it would give the whole fishing fleet a plenty of work for twenty years. It is detrimental to our future prospects to catch these fish now when the scrap is not worth 50 per cent. of grown fish. They yield only one-half gallon of oil per thousand fish. I have prohibited our gangs from catching them, and would decidedly recommend that purse-seining for menhaden with anything short of a 2¼-inch seine be prohibited. In Virginia, which I believe is the bed of these fish, they are taken with 1½-inch seines. Some eastern men are now catching them with 1¼ to 2 inch seines. We use 2¼ to 2½ inch seines at present. I am satisfied that if we had not caught the young fish in 1876 we should have better fishing now.

NEW YORK, *August* 29, 1882.

Our factory has received this season up to date 20,250,000 fish; Jones & Co. about 23,000,000 fish; and Hawkins & Co. about 20,000,000 fish. The fish commenced to appear on our coast late, which does not preclude the possibility that they were present but unnoticed before that date.

The best fish we received came from Sandy Hook and its neighborhood. Still, I think that the fish caught between Atlantic City, N. J., and the Delaware Breakwater, if received fresh, would yield fully as much oil as those from Sandy Hook.

Monthly statement of the menhadden received by the Barren Island Manufacturing Company in 1881 *and* 1882, *with the average yield of oil.*

Month.	Number of fish received.	Average yield of oil per 1,000 fish.
1881.		*Gallons.*
May	3,986,350	1.76
June	4,186,450	2.90
July	5,321,850	2.58
August	3,514,700	3.46
1882.		
May	3,144,600	2.75
June	3,461,800	5.12
July	5,999,700	5.00
August	10,000,000	5.60

Comparing these averages you must naturally conclude that the fish have left poorer feeding grounds for better ones. The Humphrey, of Tiverton, R. I., loaded up twice last week at Cape May, taking each time 600,000, all big fish, and other boats have caught correspondingly as many without driving away the fish or decreasing them according to all appearance.

Bluefish and weakfish never were more plenty on the Jersey coast than this year. The captain of one of our steamers caught by a mistake 1,078 bluefish, and all he got for them in the market was 3 cents a pound. As to stopping the catch of little fish, my neighbor, d'Homergue, agrees with me that they should not be caught. I, for one, would advocate legislation in that direction, making it a penalty to catch menhaden with any seines smaller than 2¼-inch mesh.

It stands to reason that any little fish now caught would measure in one or two years four times the size and value, so that every million caught now could represent four millions a couple of years hence. The young fish should be protected, but whether legislation is at all desirable is not for me to say. I am satisfied that a circular from you to the United States Fish Association recommending this strongly would receive prompt action from their members. Of course I cannot speak for the Virginians.

The destruction of sharks by menhaden fishermen is worth noticing. The shark is the only fish which is now regularly found among the menhaden, and I estimate that the fleet destroys 1,500 to 2,000 sharks per week. How many bluefish, weakfish, and others would the sharks destroy if living?

NEW YORK, *September* 2, 1882.

[For additional communication in 1882 see Bulletin of 1882, Vol. II, p. 252.—C. W. S.]

1883.

The indications this spring are worthy of notice. Small and large fish have appeared all along the coast from the Chesapeake to Massachusetts. The sound and bays are full of fish. Some of the traps in

the sound have caught as many as 300,000 in one week. The eastern steamers catch more there than ours do here, though all do well. We commenced on May 14, but find the fish almost naked of oil. They yield from 2 to 3 quarts per 1,000, being hardly worth pressing. I opened menhaden repeatedly within the last four weeks. All were completely void of spawn; not a particle was found in them. According to this, these fish must have spawned where they came from, and have been starving on account of the cold season having produced no food for them, or the cold winter having destroyed it. I have requested our captains to make a daily note of the progress of the spawn. According to the high wages paid to the fishermen the season looks very gloomy for profits unless the fish fatten up, but at present it looks bad. The water is as cold as ice, as if the coast was surrounded by icebergs.

NEW YORK, *June* 4, 1883.

The weather has been a great hindrance to catching menhaden thus far this season, but from all accounts they are everywhere. The Church firm is getting its menhaden factory in order, expecting fish there this year, as very large bodies of fish have gone in that direction. Their steamers loaded up on the 9th instant at Noman's Land as deep as they could swim, but the great bulk of that immense body of fish went East. Our fleet here is doing fairly when the weather permits, but although the fish of a new run are unprecedentedly big, they are poor in oil, which is a mystery to all concerned. Our catch at the Barren Island works and the oil yield has been as follows:

Dates.	Number of fish.	Average yield of oil per 1,000 fish.
		Gallons.
May 10 to 20	1,085,000	0.75
May 21 to 26	716,300	0.72
May 27 to June 2	1,706,000	0.71
June 4 to 9	802,900	1.33
June 11 to 16	1,330,900	1.00

NEW YORK, *June* 20, 1883.

Big fat menhaden have appeared again on the coast of Maine. One old steamer in three days caught 300,000, averaging over 12 gallons per thousand, while our fish continue the poorest on record. Menhaden are abundant all over the coast, and our yield of oil here has not exceeded 1.71 gallons per thousand. On the coast of Rhode Island and off the eastern end of Long Island there are more fish than there are about here, and their quality is better, yielding about three gallons per thousand.

Bluefish are not very plentiful. Our catch of sharks this year is immense, and the presence of these ferocious animals in such large bodies may account somewhat for the scarcity of bluefish.

NEW YORK, *September* 14, 1883.

113.—WHY MENHADEN SEINING SHOULD NOT BE PROHIBITED WITHIN TWO MILES OF THE SHORE.

By JOSEPH WHARTON.

[From a letter to Prof. S. F. Baird.]

Having a fishery and oil tanks in Little Egg Harbor, New Jersey, I venture to give my views on the subject of prohibiting the seining of menhaden within 2 miles of the shore.

I. Fishing by sail vessels does not destroy the menhaden in excessive quantities, does not worry them constantly in their annual cruise along our coast, and permits the fishermen of each region to enjoy what naturally belongs to their region.

II. Fishing by steamers not only permits the destruction of menhaden in quantities sufficient, perhaps, to jeopardize the keeping up adequate numbers of the fish, but tends to drive them off the coast by keeping them worried all the way from South Carolina to Maine without intervals of peace. It deprives the moderate sailing outfits of the various points along the Jersey shore and more southern coasts of their fair share of the catch, and almost destroys the fisheries of Maine and the north generally.

III. To prohibit fishing within 2 miles of the shore would simply give over the business more completely to the steamers and intensify all the existing evils. Unless the coast were patrolled by swift steam inspectors, the steamers would fish where they liked, not even obeying the law which destroyed their rivals for their benefit.

It seems to me that a law of two short sections would meet the case. Let it prohibit (1) all seine or purse fishing on the Atlantic coast by steamers; and (2) all such fishing by any craft except between June 1 and October 31.

CAMDEN, N. J., *January* 13, 1883.

114.—LARGE HAUL OF DRUMFISH.

[From the Atlantic City Review.]

A special dispatch to the Review, received last evening from Somers Point, on the bay shore, opposite Great Egg Harbor Inlet, and about 3 miles above the lower point of this beach, brought information that 150,000 drumfish were caught yesterday off that place by the fish-oil factory boats, and will be ground up and converted into fish-oil and guano. The nets used are worked by steam, and are, in some cases, a half mile long. At certain seasons the drum congregate near the surface in enormous quantities. They average 25 pounds each.

JULY, 1883.

115.—WHY THE SIZE OF MESH IN MENHADEN SEINES SHOULD NOT BE RESTRICTED.

By DANIEL T. CHURCH.

[From a letter to Prof. S. F. Baird.]

I do not believe that it is possible for man to make a perceptible decrease in sea fish. Hence we shall catch all we can of any size we can get hold of. By observation we know that, during ninety days of the year 1880, 30,000,000 barrels of menhaden were destroyed by bluefish and weakfish in Narragansett Bay, and in a tract of water only 12 miles long by 2 miles wide. As the total catch with purse seines is less than 3,000,000 barrels a year, it seems foolish to limit free fishing. If we are by law compelled to use 2½-inch seines, it is possible to stop every factory south of Montauk for years together. A large body of small menhaden are now on the coast, between Sandy Hook and the Delaware, giving us another illustration that fish go and come without any apparent cause. For the last three years the Virginians have been taking large amounts of small menhaden. Last fall we were in the Virginia waters fishing, and it was the universal testimony that there was then the largest crop of small menhaden ever known. I suppose this crop off the Delaware and Jersey is a part of the overflow, for, in my opinion, the Chesapeake Bay could not hold them after they had grown to full size.

From a selfish point of view, it would be for the interest of our firms to have the mesh restricted, and many fishermen have urged this upon me; but I have taken the opposite ground because I believe more menhaden are destroyed in one hour by fish than are destroyed by man in a year.

TIVERTON, R. I., *August* 18, 1882.

116.—THE INJURIOUS EFFECT OF MENHADEN STEAMERS UPON THE FOOD FISHERIES.

By JOHN O. BABBITT.

[From letter to Prof. S. F. Baird.]

Since the menhaden steamers have come into general use it gives those fishermen much advantage over the fish, with no law to protect the latter. It has nearly annihilated the fish from the coasts of Maine, New Hampshire, Massachusetts, and Rhode Island. If the fishermen begin next spring where they left off on the Jersey coast, judging from the decrease of the past four years, there will be but few fish seen on the

New England coast in a short time. It is a well-known fact that many of the food-fish follow in the wake of the menhaden; and it is also a well-known fact that a large proportion of the food-fish have left the coast since the menhaden have been checked. The present prices for food-fish vouch for this statement. In the spring when the menhaden leave the gulf for the Northern shores, they start in three different schools, or run but a few days apart, and if undisturbed would soon fill our sounds, bays, and rivers, from Mount Desert to Cape May. This fish is the best known bait for halibut, cod, haddock, mackerel, bass, lobsters, &c. In fact it is a fish that they all love to get a bite at. Without this bait the above fishing has proved a failure compared with what it was when there were plenty of menhaden on our coasts.

I will now show where and how the menhaden are broken up and driven from the coast. In the rear of this large school of fish there follows a large school of bluefish. About the 1st of May, there starts a fleet of steamers to meet these fish. They find them two hundred or more miles south of Long Island. Then commences the massacre, and by the time that is over the second school overtakes the first school, and their fate is nearly the same. By the time they reach Long Island the third school, driven on by the large amount of bluefish, overtakes the first and second school, and the menhaden re-form to follow the coast of Long Island. The delay these steamers have caused these fish in reaching Long Island has given a part of the bluefish an opportunity to flank, and some go to the front, off Montauk Point. About June 1, a fleet of seventy or more steamers, all engaged in catching these fish, are off Montauk Point. Before this line of steamers and the bluefish, the great school of menhaden makes a hasty retreat, going back thirty or forty miles a day. Now the steamers have all loaded and gone. As the darkness of night comes on, the fish re-form and come back where they were the morning before. The steamers have come back also. The bluefish have become hungry and want their morning's meal. Then the same battle is fought as the day before. As the steamers come onto the grounds the third morning, they still find the fish trying to get around the point, but are driven back as before. As they return on the fourth morning there are not many to be found. Nine-tenths of the fish have disappeared from the sight of man, and steam-power has not revealed their whereabouts.

What is now wanted is a law of equity to protect these fish from the purse-seine until the 1st of September in each year. By that time they will have reproduced in countless numbers, and the fish will have become ripe for the harvest. Then they, of course, belong to the fishermen. With such protection, our coast would be supplied with an abundance of fish. If neglected, it will cost the United States many millions of dollars for the privilege of fishing in the British Provinces, all of which we might have saved by careful and proper protection.

ADAMSVILLE, R. I., *January* 8, 1883.

Vol. III, No. 30. Washington, D. C. Dec. 7, 1883.

117.—NOTES ON THE ENGLISH HERRING FISHERY OF 1882.*

By THOMAS SOUTHWELL, F. Z. S.

The herring voyage of the past year has been characterized by extremes, both of catch and prices; the weather has also been extremely unpropitious, a succession of severe storms having proved most disastrous both to life and property; but during intervals of fine weather very large catches have been made, by the Yarmouth boats especially. The spring voyage from Yarmouth is never of any importance; last year it yielded 197 lasts of 13,200 fish, as compared with 236 lasts in 1881; but the Lowestoft boats fill up the time from March till the end of May, when the mackerel season commences, in fishing for herring. The spring of 1882 produced 1,793 lasts, against 2,797 lasts in 1881; the prices, too, as a rule, were very low, in some instances as low as 4*d.* per 132, and repeatedly not more than 7*d.* or 9*d.*, whilst 2*s.* 6*d.* per 132 appears to have been considered a good price. In the spring of 1881 prices ruled much higher, 12*s.* to 18*s.*, and in one instance 19*s.* per long hundred having been given. One of the reasons assigned for the low prices is that very few French boats were fishing for cod, and therefore the demand for herring for bait was much less than usual; a reason very significant of the value of these spring fish. Upon the whole the Lowestoft spring voyage may be considered to have been very unsatisfactory, many of the boats having scarcely paid their expenses.

It will be seen from the table below that herring are present in the North Sea during the whole year; and although at all times more or less gregarious, it is only during the spawning season that they congregate in the vast shoals which frequent the shallow waters around our coast; the so-called "migration" being simply the gathering together, for the purpose of reproduction, of the scattered parties which, although at greater distances from the shore, and in greater depths of water, are still permanent inhabitants of the sea.

During the months of June and July a few fish are taken, and a larger quantity in August; but it is not till September that the autumn fishery commences in earnest. From that time to the end of the year the boats are busily occupied, and the fish wharves exhibit an animated scene. There were about 50 more Yarmouth boats engaged this year than in 1881, and about 200 Scotch boats also used the port. Very large deliveries were made early in the season, and at one time the Yarmouth delivery reached about 5,000 lasts in excess of the same period of the previous year; but a succession of heavy gales, towards the end of the

* A paper read before the Norfolk and Norwich Naturalists' Society, March 27, 1883.

season, reduced this excess to about 450 lasts; whereas the Lowestoft men, who seem to have lost all spirit towards the end of the season, and were making very small catches at a time when the Yarmouth men were doing well, ended with a deficiency as compared with last year of some 2,346 lasts (representing, at £15 per last, a money value of £35,490), not to mention loss of gear from stress of weather and Ostend trawlers. Prices, as usual, fluctuated from £5 to £36 per last, according to quality or supply.

The following table will show the results of the year's fishery from Yarmouth and Lowestoft. As the spring, summer, and autumn voyages merge into each other, and any division must be arbitrary, I give a continuous monthly record for the whole year. For the Yarmouth return I am indebted to Mr. H. Teasdel, jr., the corporation accountant, and for Lowestoft to Captain Massingham, harbor-master at that port.

Return of herring landed at the Yarmouth and Lowestoft fish-wharves in 1882.

Seasons.	Months.	YARMOUTH.			LOWESTOFT.		
		Lasts (13,200).	Thousands (1,320).	Hundreds (132).	Lasts (13,200).	Thousands (1,320).	Hundreds (132).
Spring	January	.....	.....	.....	.....	.....	.....
	February	.....	.....	.....	.....	.....	.....
	March	31	1	5	212	4	2
	April	162	4	1	1,567	5	9
	May	4	2	8	13	7	6
Summer	June	6	6	9	14	2	2
	July	33	4	1	10	9	4
	August	938	6	5	102	2	1
Autumn	September	3,238	4	2	210	2	1
	October	7,833	5	5	2,914	9	4
	November	3,920	.....	1	1,582	2	4
	December	986	1	5	440	7	8
		17,154	7	2	7,069	3	1

118.—SCOTLAND FISHERIES AND APPARATUS.

By JOS. JOHNSTON & SONS.

[From a letter to Prof. S. F. Baird.]

Recently, at the London Fisheries Exhibition, we had a conference with your people about the method of using the purse-seine in the waters of the United States, and would be obliged if you would send us your History of the Mackerel Fishery and the United States Fish Commission Bulletins. We are interested in all kinds of fishing, being tenants of salmon fisheries, chiefly on the sea-coast of Scotland, which rent at £9,000 per annum. We are also interested in all sea fisheries, such as herring, cod, ling, halibut, &c. We are now building two steamers, each 116 feet long, to fish with beam-trawl and purse-seines, the latter being quite new in this country, but we are to make a trial of it

MONTROSE, SCOTLAND, *August* 17, 1883.

119.—FLUCTUATIONS IN THE FISHERIES OF THE GULF OF MEXICO AND THE PROPOSED INVESTIGATION OF THEM.

By SILAS STEARNS.

[From a letter to Prof. S. F. Baird.]

As to the best time of year for the Albatross to visit the Gulf, I would say that I think that much more could be accomplished in summer than in winter. For in winter the cold "northers" drive the most of the animal life from the shores and shoaler waters to deep waters, or in the case of surface swimmers, large and small, to the lower parts of the Gulf, perhaps even beyond Cuba. This movement takes place more or less with all of our food-fishes. The summer time is the general spawning season. West Indian forms are present, and all kinds of delicate invertebrates are more easily secured. I would say that from June until the mullet-spawning season, in September, your expedition would do better than at any other time. Most persons do not find the climate on the Gulf at all unpleasant in summer, and then the moderate winds and calm sea are most favorable for collecting. I am pleased to know that you are contemplating this exploration, and trust that the plan may be carried out, for it seems time that we were better acquainted with our food-fishes, which appear to be more easily used up or driven away than they are in more northern latitudes.

I am aware that fishermen are apt to fancy that fish are becoming scarce whenever they have been unusually unsuccessful for a season, remembering only the good catches of the past, but it is quite evident that their complaints are well founded in this case. For the past five years the daily catch of the shore seine-boats from the Mississippi River to a point 50 miles east of Pensacola has been gradually reduced, so that now it is very small. To get even half a supply there are many more boats and vessels, much larger than of old, that carry ice and scour the coasts westward and southward, going in the latter direction 300 to 400 miles. It seems strange to me that the fishery of a few years past, which was not large, should almost entirely use up an abundance of fish. The scarcity is with the following species, which are inhabitants of the bays all the year: Sheepshead, salt-water trout, redfish, mullet, gray snapper, and other small species. These fishes are yet abundant in Southern Florida, as they used to be here. The pompano, bluefish, Spanish mackerel, &c., all migratory, are, apparently, as abundant as ever some years and scarce others. I think also that there has been a decrease with the red snapper, for the most of the old fishing grounds are barren, and smacks have to go farther each year to find new ones. During the past winter we have fished along the edge of the 100-fathom curve in 30 to 40 fathom water from south from Pensacola to west from Cedar Keys, which takes us from 50 to 200 miles from home.

Beyond these limits we have found no fish. A comparison of a fishing chart of 1878 with one of 1883 shows great changes for so short a time. During the spring large schools of red snappers come inshore—perhaps after small fishes—but they swim at the surface, and cannot be taken with hook and line. The Key West grouper fishermen have been able to catch but few fish of late. They say that their grounds, which extend from Key West to Cedar Keys, are worn out. As other and improved means are adopted to secure fish, there will no doubt prove to be a sufficient supply for a long time, but when we find them disappearing so fast before our comparatively small fishery we are inclined to look farther into the future than we otherwise would.

Should the Albatross come this way I will take pleasure in doing anything that I can to forward the exploration, and, if my personal services would be acceptable, can direct her to all of the fishing grounds, &c.

I will undertake to do something at once in regard to the collection of porpoises. Nearly every day at sea they play about the smacks and could be easily harpooned. I do not think that there are any harpoons in the city, but will look around to-morrow. There are seemingly at least three kinds of porpoises, besides the so-called blackfish, sperm-whale, and finback whale. The larger porpoise, uniform brown, lives in the bays and at sea, sometimes straggling a mile or so up fresh-water rivers. The two smaller kinds, one plain brown and the other mottled with white, live exclusively at sea, I think.

Whales seldom come inside of 40 fathoms of water, but black fish are seen within a half mile of the beach.

PENSACOLA, FLA., *May* 5, 1883.

120.—PROPOSED LIMITATION OF MENHADEN FISHING TO JUNE 1, AND OF MACKEREL FISHING TO JUNE 15.—OCCURRENCE OF HERRING.

By W. A. ABBE.

[From letters to Prof. S. F. Baird.]

It seems to me that an easy way to settle the dispute between the shore fishermen, or the amateur fishermen on the Jersey coast, and our menhaden fishermen is to pass a general law refusing to grant fishing or coasting licenses to menhaden fishermen before June 1 of each year. This would allow the fish to settle on their feeding grounds, and I am confident that they would return to the Maine coast.

NEW BEDFORD, MASS., *September* 7, 1882.

I have recently conversed with a good many owners and fishermen from Booth Bay to Portland, and have been surprised to find such a general sentiment in favor of a law restricting the catching of mackerel before June 15. I am assured also that the same sentiment exists at

Gloucester and Provincetown. I am not specially interested in the mackerel fishery, but I am largely in the menhaden.

There was an enormous body of herring on the coast about the first week of September. Great schools of them were seen in Ipswich Bay, and from Cape Ann to Portland. I had no information about them to the westward of Cape Cod.

NEW BEDFORD, *October* 13, 1882.

121.—WHY THE CATCHING OF MENHADEN WITH SEINES, ETC. SHOULD BE RESTRICTED.

By DAVID F. VAIL.

[From a letter to Prof. S. F. Baird.]

I have observed that the fish come in the spring at about the same time regardless of weather, and that there are large schools of spawning fish. They come for that purpose and ought to be protected if possible. If there is not some law passed to prohibit the catching of these fish on this coast with purse nets, pounds, and other traps, during the months of April and May, it will be only a few years before the menhaden will be annihilated as completely as they have been on the coast of Maine.

I know a good many of my brother manufacturers will not agree with me; but the reason is that they have steamers that can go down the coast during the months of April and May and catch up these spawning fish before they get to their spawning grounds. It is my belief that if the fish could be left until the spawning season is over, they would catch just as many fish and leave the spawn to grow up and make fishing good for years to come. I am the oldest person in the business, except one, that I know of. I have been engaged in it the last 20 years, and have watched it from year to year.

RIVERHEAD, N. Y., *February* 20, 1883.

122.—OCCURRENCE OF BALISTES CAPRISCUS GMELIN (LEATHER-JACKET OR FILE-FISH) AT NEW BEDFORD, MASS.

BY THOMAS R. LUCE.

[From a letter to Prof. S. F. Baird.]

The fish which I send by express was caught to-day in the waters of this place near Round Hills. I was fishing in about 2 fathoms of water, with lobster bait, for tautog, and succeeded in catching three of these, much about the same time. I therefore think they must have run in schools. Please inform me of its name.

No. 127 CEDAR STREET, NEW BEDFORD, MASS.,
September 25, 1883.

123.—MOVEMENTS OF MENHADEN—CATCH OF HERRING.

BY ISAAC H. GRANT.

[From a letter to Prof. S. F. Baird.]

I have made extensive inquiries as to the return of menhaden to this coast, and believe that, in general, there is no ground for the report, though a few have been caught at different localities. Near Bristol, Me., quite a large quantity was caught in a weir. At the mouth of Weekeag River, South Thomaston, three menhaden were caught in a herring weir, but no schools of menhaden have been seen, to my knowledge. The movements of these fish are watched here with much interest, as their departure from Maine waters has entirely changed the manner of obtaining bait. Our fishermen now depend almost entirely upon herring caught in the numerous weirs which have been built in the coves and sheltered waters along the coast. For these they pay from 40 to 60 cents per bushel. Many large hauls are obtained in these weirs, 200, 300, and often 400 bushels of herring oftentimes being taken in a night. After the fishermen have been supplied, the surplus is sold to the "sardine" factories, which have small steamers running about to collect them.

WHITE HEAD LIGHT STATION,
Spruce Head, Me., September 25, 1883.

124.—MOVEMENTS OF MACKEREL.

By S. J. MARTIN.

[From a letter to Prof. S. F. Baird.]

I have been requested by many mackerel fishermen to call attention to the statement of Capt. David Plummer, master of the ship H. S. Sanford, dated New York, August 28, 1883. He says: "On my late passage from Bath to this port, on the 23d instant, in latitude 40° 24′ longtitude 67° 40′, just on the edge of the soundings, with a temperature of water at 70°, showing that we were within the influence of the Gulf Stream, we were for several hours surrounded by large schools of mackerel."

The fishermen are of the opinion that the large mackerel may be staying in those warm waters instead of going further north. It is of immense importance to the mackerel fishermen to know where the fish can be found. They would at once proceed to those waters if they could be confident that the fish seen by Mr. Plummer were really mackerel.

GLOUCESTER, MASS., *September* 1, 1883.

125.—MOVEMENTS OF MACKEREL.

By Capt. Z. L. TANNER.

[From a letter to Prof. S. F. Baird.]

I have just read Captain Martin's letter of September 1. We saw mackerel ten days later NE ½ E, 129 miles from where Captain Plummer saw them, and in practically the same temperature, 69°, on the verge of the Gulf Stream. It is my impression that we saw the same school, as a movement of 13 miles per day would have placed them in our locality. We passed over the region referred to between the 2d and 5th inst., and on the latter date were at the spot where the mackerel were reported to have been on August 23.

STEAMER ALBATROSS, WOOD'S HOLL, MASS.,
September 7, 1883.

126.—SUCCESS IN PROPAGATING CALIFORNIA MOUNTAIN TROUT FROM EGGS BROUGHT TO MICHIGAN BY THE UNITED STATES FISH COMMISSION.

By MARTIN METCALF.

[From letters to Prof. S. F. Baird.]

I am now taking the eggs of the California mountain trout from fish reared from the ova furnished by the United States Commission three years ago the present month. I have individual fish of this species, reared from the eggs aforesaid, that will weigh hard on to 3½ pounds. Shall endeavor to-morrow to fertilize a few eggs with the milt of the Michigan grayling.

BATTLE CREEK, MICH., *March* 3, 1883.

I should take exception to the proposed expunging of the words "more vigorous"* as applied to the rainbow trout in comparison to what is called brook trout proper.

After an experience of four years with this variety, kept under like conditions, I can say that, *with me*, they are so much "more vigorous," hardy, voracious, and desirable every way for our Michigan streams, now denuded of forests, that the brook trout is not to be thought of in comparison.

During spawning time—that time of trial to all the salmonoids kept in comparative confinement—the California mountain trout thrive and

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* The reference is to remarks of Livingston Stone, on pp. 11–12 of F. C. Bulletin, 1882, Vol. II, where he proposed "more hardy" as a better phrase than "more vigorous" when comparing *California trout with brook trout*.—C. W. S.

manifest a freedom from disease, such as "fungus" and kindred ailments, that is marvelous.

Added to this, they are far more rapid growers, attaining *four times* the size of brook trout in the same time and with equal feed; and can be kept in temperatures many degrees higher than any of the salmon family with which I have had to do.

BATTLE CREEK, MICH., *September* 29, 1883.

127.—EXCHANGE OF LIVE MARINE SPECIMENS WITH FRANCE.

By FRED MATHER.

[From a letter to Prof. S. F. Baird.]

I have to-day received four living specimens of the loach, *Cabitis fossalis*, from Captain Briand, of the steamship Normandie. He brought these from Paris on the last trip. I understand that they were bred in France by the late M. Charbonnier, from parents brought from Russia. Madam Charbonnier, who seems to share the tastes of her late husband, wishes some of our small sunfish and pond turtles, which I will send her by Captain Briand.

COLD SPRING HARBOR, N. Y., *October* 2, 1883.

128.—THE SCOTCH HERRING FISHERIES.

[From the London Daily Telegraph, August 30, 1883.]

In the instructive paper prepared for the fisheries conferences by the Duke of Edinburgh, the money value of the fish taken off the coasts of these islands is estimated by his Royal Highness at £7,380,000 ($36,900,000). The Scotch herring fisheries alone cured, in 1880, nearly a million and a half barrels of herring, and exported nearly a million. Now, a barrel is calculated to contain 800 or 900 fish, and will sell on an average for 25 shillings. According to this estimate the value of the herring cured in Scotland that year was about £1,842,000. Some 20 per cent. of the Scotch herring, however, are sold fresh, and at prices at least equal to that of the cured fish; so that the sum total realized by one year's herring fishing in the lochs and on the coasts of Scotland would fall little short of £2,250,000. As good a tale could be told, no doubt, for Yarmouth and the other great English fisheries; nor must we lose sight of the fact that while the herring, in its adult state, is the cheapest and one of the most wholesome luxuries of the poor, that which is supposed to be its tender fry, known as whitebait, is an esteemed delicacy of the rich, and is devoured in quantities that would seem wasteful were it not for the proofs which are from time to time forthcoming of the inexhaustible character of our herring supply.

129.—TROUT AND TROUT CULTURE.*

By R. A. KOSS.

The brook trout belongs to a family of fish the members of which are distinguished for their delicate flavor, and among which the salmon, the king of all food-fish, occupies the most prominent place. The trout is one of our most valuable fresh-water fish, and recommends itself to the pisciculturist by many excellent qualities. The clearer, colder, and more rapid in their flow the waters are in which the trout lives the darker is its peculiar many-colored skin. It seems as if nature took special care not to make its appearance too striking so as to attract the attention of its enemies, of whom man, after all, is not the worst. The trout, which in brooks reaches a weight of about three pounds, seldom more, is a very hardy fish and not very choice in its food. It is not timid, and can even be easily tamed, in which case, on account of its voracity, it can be accustomed to take its food from a man's hand. It is particularly well adapted to pisciculture, because its eggs are very hardy and can easily be transported a considerable distance. Its power of digestion is very extraordinary, and when well fed it grows quicker than most other fish. Its food is exclusively animal, consisting principally of insects, larvæ, snails, and other small animals. All these water animals need aquatic plants for their existence, and these plants are, therefore, necessary indirectly to the trout. It occasionally eats fish, but never shows as much liking for them as for the other articles of food mentioned above. When a number of trout living together have sufficient food there will be among them but very few which eat fish, perhaps only one in a hundred, provided that the difference of size is not too great. The trout which eat fish grow quicker than their comrades; in retired places they lead the life of hermits, and their flesh is less delicate than that of other trout. If one succeeds in catching these destructive individuals no more fish will be eaten, for in the shallow brooks there will rarely be any other fish of prey. Trout do not like the company of other fish; it is well, therefore, to keep them separate from other fish as much as possible.

For spawning places the trout prefers shallow spots with a gravelly bottom, over which the water flows slowly and with broken force; the fecundity of the trout in a certain body of water depends altogether upon the extent of suitable spawning places. Whenever a brook has large stretches of gravelly bottom over which the water flows gently, it may be assumed with a great deal of probability that it contains trout. For supplying trout with food it is well if there are occasionally places where the bottom is muddy or peaty; a slow current is also much to be preferred to a rapid current flowing over a rocky bottom, because

* "*Forellen und Forellenzucht.*"—Translated from the German by HERMANN JACOBSON.

the former favors the development of water plants and small aquatic animals. Trout are very numerous in clear mountain streams, flowing rapidly over their rocky beds, because they like the character of the water; but they remain small, and do not get very fat; while slowly-flowing rivers, having muddy bottoms, but fed by many gravelly brooks, where the fish can retire for spawning, produce the largest, fleshiest, and best-flavored trout, which fetch the highest price in the market. It is a very general, but nevertheless erroneous, notion that trout only live in water which is clear and transparent as crystal; on the contrary, they seem not in the least disturbed by the water being muddy, and, as we have seen, a muddy bottom even favors their growth. In Norway, which is famous for its delicate trout, they flourish most in rivers and brooks with muddy bottoms, provided suitable spawning-brooks are within easy reach. If there are in a body of water many stagnant places where aquatic plants grow in profusion, and hollow banks with entangled roots of trees and similar hiding places, the trout will flourish, even if the water does not flow very freely. Thus the river Leith, in Scotland, for example, is so shallow in many places during the summer that one can almost walk from bank to bank without wetting his feet; but it possesses a series of stagnant puddles extending for miles, which harbor an abundance of very large and delicately-flavored trout.

It is likewise an erroneous idea that trout require very cold mountain water; they are, on the contrary, very well able to stand warm water, such as is found in the plains during the hot season. It has been observed in Germany that trout streams reached a temperature of 21, and even 26, degrees Réaumur, without in the least injuring the fish. A warm temperature of the water is even beneficial to trout, as it increases their food very considerably, which is an important item, considering their voracity. It is well, however, for trout streams flowing through a plain to have here and there along their banks bushes and shade trees, for during the heat of the day trout love to stay in such shady places, as under the overhanging branches and among the roots they find an ample supply of food, principally insects, which generally live on the leaves and are thrown into the water by the wind.

Trout-culture is made comparatively easy by the circumstance that no other fish stays as steadily in one place without ever going far from it as the trout. Any person who lives near a stream, and is in the least observant, will be able to indicate the exact place of sojourn of this or that particularly striking individual trout. Apart from the spawning season the trout live permanently in a body of water extending frequently not more than 50 to 100 feet, which enables the proprietors of small bodies of water to use them advantageously for trout-culture. When trout are well taken care of they prefer to stay within narrowly-confined limits; they learn to know man, approach him without fear, and even jump out of the water to get some food which is held out to them, in which case, however, one has to be careful not to get hurt by their sharp teeth.

If trout are well fed they begin to spawn when two years old, and it has even happened that trout only one year old have been known to discharge mature spawn. Two-year-old trout lay from two hundred to five hundred eggs, three-year-old ones about a thousand, and those from four to five years old even as many as two thousand. To stock a moderately-sized stream with trout requires at least ten thousand young fish per annum. If this has been continued for three years one may, with tolerable certainty, count on good trout-fishing. As a general rule trout flourish better in brooks, where they take care of themselves, than in ponds, where they have to be fed artificially. They need human protection only until they are able to seek their own food. Where there is no running water they can be kept in that which is still, provided that the latter is constantly kept pure by inflowing springs.

If there are no suitable natural spawning places a spawning and hatching establishment may take their place; and it is well known that during the last decades a great deal has been done in the way of artificial trout-culture. It requires a good deal of technical knowledge to start and superintend such establishments, but the expenses are very trifling compared with the great profit. Natural trout-culture is much less profitable, because it has been calculated that, left to themselves, one thousand eggs will produce, on an average, only one fish, whilst in a well-conducted piscicultural establishment eight to nine hundred fish may be raised from the same number of eggs. The very waters in which trout flourish most have frequently no suitable spawning places, and if the supply is limited to the result of natural propagation the trout must soon die out, or, at any rate, become very scarce. Young fry from a piscicultural establishment are best placed at first in small streams or brooks with a gravelly bottom and retained there for some time by means of a wire grating.

As trout find much more food in the brooks and streams above referred to [sluggish, well-shaded waters] than in gravelly mountain streams, and consequently grow faster and acquire a more delicate flavor, a wide and exceedingly profitable field is here opened to the pisciculturist. The prejudice that trout are difficult to raise and that they are very choice in the selection of water cannot be sufficiently combated. As soon as they are able to forage for themselves they will be satisfied with almost any kind of water, provided it contains sufficient food. A brook containing pike and perch, but no spawning places for trout, will have to be stocked with ten times as many young fry, if any good fishing is looked for, as are required for an open mountain stream which is free from those two fish; but by means of artificial pisciculture the necessary quantity of young fry can easily be procured.

Mr. Peard, an Englishman, has made very practical suggestions for improving small trout-brooks. As we have seen, trout flourish best in streams which have not only a gentle current of water flowing over even places, but also a considerable number of large, deep, and calm

pools. These are the favorite hiding places and winter quarters of the fish, as the aquatic plants grow in profusion in quiet water, supplying ample nourishment for insect life, and quantities of food are usually brought together in such places by the currents. Wherever there are no such pools they can easily be made artificially, for which purpose cross-dikes are constructed in the bed of the stream, at a distance of one hundred to one hundred and fifty feet, and strengthened by sod, sand, and stones. Below these dikes holes are dug, three to five feet deep and six to seven feet long, in each of which are placed some large and several small stones, or flagstones. The fish are thus provided with suitable hiding places, and fish thieves are foiled in their endeavors to catch trout with nets. As these dikes produce small waterfalls, the pools are increased by every high water, if proper care is only taken that the floods do not carry the dikes away. They should extend several feet on the bank, so as to prevent the water from flowing past them; and then the soil carried along by the stream will continually make the dikes stronger and stronger.

In our age, when it is often so exceedingly difficult for a man to make a living, it is absolutely necessary for the farmer and landed proprietor to husband his resources, and to derive the greatest possible benefit from his property. A stream or a pond, unless used for purposes of irrigation, was formerly considered almost like dead capital, and attempts were even made to lay it dry, with the view of using the land thus gained to greater advantage. In our days no landed proprietor should be found guilty of such folly. By utilizing such waters for pisciculture, the first expenses of which are, as a general rule, very slight, a tenfold greater profit can be realized than by laying them dry and using them for agricultural purposes. In nearly every part of our country there are thousands of such ponds and streams which at present are entirely useless, but which if stocked with fine food-fish would become a rich source of income to their owners. Of all the various branches of pisciculture, trout culture is certainly the easiest and most profitable, and all persons who are in any way in a condition to carry on this business should give all possible attention to it.

130.—SCARCITY OF SALMON IN THE LITTLE SPOKANE AND OTHER STREAMS ON THE PACIFIC COAST.

By LIVINGSTON STONE.

[From a letter to Prof. S. F. Baird.]

It looks as if this year would prove a poor one for salmon at the Spokane River as well as McCloud River. A letter from Lane C. Gilliam, of Spokane Falls, Wash., dated September 17, 1883, says: "I have just completed my second trip to Little Spokane, and as yet no salmon to speak of are running. The Indians, who are encamped here in great

numbers anticipating a large run, are uneasy and fear the fish are not coming. Yesterday morning they caught eight, which was the largest number taken at any one time as yet. A white man living in the neighborhood told me that last year he made a rough estimate of the salmon taken by the Indians. He thinks they had between 40,000 and 50,000 drying at one time, about October 1. I will make another investigation about October 1."

The injury to the McCloud River salmon this year, due to the blasting of the Northern Pacific Railroad, which will be completed this winter, is, I am happy to say, in all probability, but temporary. The next year's run will probably be the same that it would have been if the railroad had not been built.

The result of my researches on the Snake River are that no salmon ascend as high as the crossing of the Utah and Northern Railroad, and that there are no salmon as high as the foot of the American Falls on the Oregon Short Line Railroad. The salmon probably cannot get over Shoshone Falls. In the spawning season there are a great many salmon at the foot of these falls, 27 miles from the Oregen Short Line Railroad.

CHARLESTOWN, N. H., *October* 5, 1883.

131.—TOTAL AMOUNT OF SHAD AND HERRING CAUGHT ON THE POTOMAC RIVER DURING THE SPRING OF 1882.

By GWYNN HARRIS,

Inspector of Marine Products for the District of Columbia.

During the month of February there were 5 shad and 925 herring caught. The first shad was caught February 21, about 75 miles down the river, and just below Mathias Point. The totals for the season are as follows:

	Shad.	Herring.
Landed in Washington	349,140	6,500,726
Landed in Alexandria	105,000	3,600,000
Landed in Georgetown	8,000	815,000
Shipped to Baltimore from Glymont	3,372	.....
Sold on different shores	2,500	600,000
Totals	468,012	11,515,726

Some of the fishing shores have quite a local trade; for instance, Chapman's, Budd's Ferry, Moxley Point, Bryant's Point, Freestone, and other shores. I think the estimate for these sales is small. The amount put down for Georgetown I think will also include the fish caught at Little Falls and Chain Bridge.

WASHINGTON, D. C., *July* 1, 1882.

132.—DATES OF THE APPEARANCE OF HERRING, SHAD, BASS, TAUTOG, SCUP, FROSTFISH, FISH-HAWKS, KINGFISHERS, AND GREENLAND SEAL IN TAUNTON RIVER, FROM 1871 TO 1883, INCLUSIVE.

By ELISHA SLADE.

[From a letter to Prof. S. F. Baird.]

Table of the dates of the appearance of six species of fish and of two species of fish-eating birds in Taunton River, Somerset, Bristol County, Massachusetts, latitude 41° 47′ N., longitude 71° 8′ W., from 1871 to 1883, inclusive.

Years.	Herring (*Pomolobus pseudoharengus*).	Shad (*Alosa sapidissima*).	Bass (*Roccus lineatus*).	Tautog (*Tautoga onitis*).
1871	March 7	March 14	March 19	April 27.
1872	March 21	March 27	March 31	May 8.
1873	March 27	March 31	April 2	May 13.
1874	March 19	March 23	March 21	May 8.
1875	March 28	March 30	April 4	May 16.
1876	March 19	March 31	March 30	May 4.
1877	March 15	March 30	March 28	May 1.
1878	March 5	March 26	March 17	April 25.
1879	March 17	March 24	March 21	May 9.
1880	February 28	March 10	March 15	April 20.
1881	March 14	March 21	March 24	April 29.
1882	March 5	April 3	April 1	May 7.
1883	March 22	April 5	April 6	May 2.

Years.	Scup (*Stenotomus argyrops*).	Frostfish (*Microgadus pruinosus*).	Fish-hawk (*Pandion haliaëtus*).	Kingfisher (*Ceryle alcyon*).
1871	June 3	November 27	March 11	March 7.
1872	June 10	November 20	March 24	March 22.
1873	June 13	November 28	March 28	March 24.
1874	June 8	November 21	March 20	March 19.
1875	June 12	November 30	March 26	March 28.
1876	June 2	November 22	March 28	March 20.
1877	June 6	November 29	March 27	March 18.
1878	May 28	November 30	March 22	March 2.
1879	June 4	November 28	March 21	March 14.
1880	May 27	November 20	February 20*	February 27.*
1881	June 7	November 26	March 17	March 12.
1882	June 15	November 23	March 31	April 1.
1883	June 8	November 19	March 20	March 16.

* Fish-hawks and kingfishers remained throughout the winter of 1879–'80.

The appearance of the Greenland seal, *Phoca Greenlandica*, in Taunton River during the past 12 years has been as follows: 1871, December 1; 1872, December 6; 1873, November 29; 1874, December 5; 1875, December 1; 1876, December 1; 1877, November 29; 1878, November 26; 1879, December 9; 1880, November 26; 1881, November 26; 1882, November 28; 1883, December 2.

SOMERSET, BRISTOL COUNTY, MASSACHUSETTS,
November 20, 1883.

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