

REPORT OF THE COMMISSIONER.

A.—GENERAL CONSIDERATIONS.

1.—INTRODUCTORY REMARKS.

It is proposed to give in the present report (the twelfth of the series) an account of the plans and results of the work of the U. S. Fish Commission during the calendar year 1884. This, with the preceding reports, covers thirteen years of activity—from the year 1871 to 1884, inclusive.

It is to be borne in mind that the work of the Commission at its commencement, in 1871, was limited to investigations into the causes of, and remedies for, the decrease of the food-fishes on the sea-coast and in the lakes of the United States, and that in 1872 the work of propagation of food-fishes was added to the functions of the Commissioner. Giving the fullest interpretation to these requirements, the work of the Commission is now divided into the two divisions of inquiry and of propagation, certain additional subjects of attention connected with the history and condition of the inhabitants of the waters that do not come specifically under either of these heads forming a third section.

Under the head of inquiry are prosecuted researches, not only into the habits and characteristics of the fishes themselves, but into their general relationships to each other and to man; the statistics and methods of their capture; the influences exerted upon their movements by physical and other causes; and, in short, whatever information is necessary for a satisfactory and proper treatment of the general subject. It was in connection with this matter that co-operation was extended to the work of the United States Census of 1880, by which the Fish Commission took charge of the collecting of all the statistics of the fisheries considered desirable by the Superintendent of the Census, and carried the work to a satisfactory termination, resulting in the production of a series of valuable reports which are now being printed under the auspices of the Census Bureau or by the Fish Commission, under authority of Congress.

The phrase "propagation of food-fishes" covers all the methods by which new varieties of fishes, mollusks, &c., are introduced into given waters or increased in their native localities; this being done either by transfer and colonization or by artificial propagation.

As stated in previous reports, the Fish Commission has been enabled to do a great deal incidentally in the way of promoting science and education; especially by the discovery of many rare forms of life in the waters, and by the accurate labeling and extensive distribution of duplicates of these objects to colleges and academies throughout the country; the reserve specimens, of course, going, under the law, to the National Museum.

In addition to the usual routine operations of the Commission during the year, in the way of general administration, of inquiry, and of propagation, the following specially noteworthy points may be indicated as having engaged its attention. These will be referred to more fully hereafter:

1. The vigorous prosecution of work on the Wood's Holl pier and breakwater, the completion of the quarters and water-tower buildings, and the commencement of the hatching house.
2. The construction of oyster ponds at Wood's Holl and at Saint Jerome station, and the investigation of the oyster-beds of Chesapeake Bay.
3. The trip of the Albatross to the Caribbean Sea for the purpose of prosecuting hydrographic and fisheries work.
4. The investigation of the Florida shad fisheries by the steamer Fish Hawk.
5. The examination of the oyster-beds of Long Island Sound by the steamer Lookout, under the direction of Mr. E. G. Blackford.
6. The investigation of the fish epidemic in Lake Mendota and other lakes of Wisconsin.
7. The collection of specimens of Cetaceans, through the co-operation of the Life-Saving Service.
8. The construction of a third car for transporting and hatching fish and eggs.
9. The introduction of the cod gill-net upon the Pacific coast.
10. The occupation of Fort Washington, on the Potomac River, for shad hatching, by permission of the Secretary of War.
11. The occupation of a station at Weldon, N. C., for propagating striped bass or rockfish.
12. The efforts to hatch the codfish at the Wood's Holl station.
13. The planting of lobsters in Chesapeake Bay.
14. The importation of blue carp from Germany, and of the European trout (*Salmo fario*) from Germany and England.
15. The appointment by the Senate of a standing committee on fish and fisheries, to consist of seven Senators.
16. The appropriation by Congress of \$75,000 for the purpose of making exhibits at the New Orleans Exposition.
17. The passage of bills in Congress, to prohibit the use of nets in capturing fish in the District of Columbia, and to prevent the discharge of refuse from the gas-works into the Potomac River near Washington.

A more detailed statement of the ends which the Commission is at present endeavoring to accomplish will be found in the Commissioner's report for 1883 at page xx.

The amount of work connected with the administration of the business of the Commission for the year has been fully equal to that of 1883. The number of sets of vouchers prepared in duplicate, audited, and properly settled footed up to 2,769; the number of letters written during the twelve months ending June 30, 1884, amounted to 8,836; of letters received, 13,744. Of applications for fish 10,300 were received, or an aggregate of 35,649 documents require entry, analysis, and indexing.

No casualties have occurred during the year in the immediate *personnel* of the Commission, and no serious interruption of work in consequence of the death of any of its members. I may, however, mention the death of Mr. Reuben Wood, of Syracuse, N. Y., on February 16, 1884; a gentleman well known in New York as an angler, and who represented angling interests in the display of the U. S. Fish Commission at the London Fisheries Exhibition of 1883.

2.—PRINCIPAL STATIONS OF THE COMMISSION.

A.—INVESTIGATION AND RESEARCH.

1. *Gloucester, Mass.*—In the summer of 1877 Gloucester was made a station for the fisheries investigations, and an office established, through which it became possible to secure a great amount of help from the fishermen in the way of contributions of information and of specimens brought in from the Banks. The office was placed in charge of Capt. S. J. Martin. A reorganization of this office was made in February, 1885, by putting Mr. W. A. Wilcox, formerly secretary of the Boston Fish Bureau, in charge; and to him, with Captain Martin as assistant, has been given authority to collect the statistics referred to, which he has accomplished in a more thorough and exhaustive manner than has heretofore been done. The information thus obtained has been of the utmost importance and of a character greatly needed for determining the value to us of the fishery operations, and especially of the participation in the British inshore fisheries. The expiration of the treaty of Washington on June 30, 1885, makes this information of very great usefulness.

2. *Wood's Holl, Mass.*—This station, which is in charge of Capt. H. C. Chester, is increasing rapidly in prominence in the operations of the Commission in connection with the approaching completion of the buildings authorized by Congress for the prosecution of special researches, and the practical propagation, in an artificial way, of cod, mackerel, lobsters, and other sea fish. A fuller account of the plant and operations at Wood's Holl, will be given hereafter.

3. *Saint Jerome, Md.*—This station, which is in charge of W. de O. Ravenel, is maintained especially for practical tests in oyster culture.

B.—PROPAGATION OF SALMONIDÆ.

4. *Grand Lake Stream, Me.*—The propagation of the landlocked or Schoodic salmon is carried on here under the direction of Mr. Charles G. Atkins.

5. *Bucksport, Me.*—The work of this station, also in charge of Mr. Atkins, is primarily connected with the multiplication of Penobscot salmon.

6. *Northville, Mich.*—At this establishment is carried on the propagation of whitefish, the eggs of which are collected by Mr. F. W. Clark and his assistants, and either forwarded to distant points or entirely hatched out and the minnows transmitted to suitable localities. The station is also used for breeding the Eastern brook trout and the California trout.

7. *Alpena, Mich.*—This is an auxiliary station for the whitefish service, and is also under the direction of Mr. Clark.

8. *Baird, Shasta County, Cal.*—This station, on the McCloud River, is devoted exclusively to the cultivation of the California salmon, for which it is eminently adapted. The work was suspended during the present year.

9. *Trout ponds near Baird, Shasta County, Cal.*—This station, situated about 5 miles from the salmon station, is devoted to keeping up a large stock of California trout to supply eggs for eastern waters.

10. *Wytheville, Va.*—This station is rented from the Virginia fish commission in order to obviate the expense otherwise attendant upon the transporting of the young Salmonidæ, such as California trout, brook trout, landlocked salmon, &c., from Northville, Mich., and other stations, to distant points, especially the southern Alleghanies.

11. *Cold Spring Harbor, N. Y.*—For the purpose of hatching eggs of the salmon and of the whitefish for introduction into the rivers and lakes of Northern Pennsylvania, New York, and other adjacent States, arrangements were made through Mr. E. G. Blackford, one of the fish commissioners of New York, to occupy, in part, the station of the New York fish commission at Cold Spring Harbor, Long Island. This place is in convenient proximity to New York, and consequently enjoys excellent facilities for transportation and distribution. It is in charge of Mr. Fred Mather, who carries on, simultaneously, work for the State of New York and for the United States.

C.—PROPAGATION OF SHAD.

12. *Battery Station, Havre de Grace, Md.*—The work connected with the propagation of shad in their breeding grounds in the Susquehanna River, previously carried on by barges anchored in Spesutie Narrows, has been transferred to an island known as Battery Island, which is a

few miles below the railroad bridge at Havre de Grace. The facilities already established at this station were extended during the year, with the expectation of their yielding large results.

13. *Central Station, Washington, D. C.*—This station, established in the old Armory building, now constitutes an important point for hatching shad, herring, salmon, whitefish, and several other species, and for their distribution by cars to distant parts of the country.

14. *Fort Washington, Md.*—This point was occupied in 1883 for the first time, by permission of the War Department, and placed in charge of Lieut. W. C. Babcock, U. S. N. Its occupation was continued by Lieutenant Babcock during the season of 1884, and large quantities of shad eggs were collected and sent to Central Station for hatching.

D.—PROPAGATION OF CARP.

15. *Monument Reservation, Washington, D. C.*—This is the principal station for the production of carp. The varieties cultivated are the leather and mirror carp. Goldfish (*Cyprinus auratus*), golden ides, and tench are also raised in considerable numbers.

16. *Arsenal Grounds, Washington, D. C.*—Cultivation at this station is confined to the scale carp.

Fuller details in regard to the work and results of all these stations will be found under the head of the specific work for which they are maintained.

3.—NEW HATCHING STATIONS DESIRED.

Efforts are constantly being made to induce the Commission to increase the number of propagating stations in order to hasten the accomplishment of the results desired; but it has been necessary to proceed very carefully with such measures, and only in proportion to the increase of appropriations made by Congress. There is no doubt that a number of new stations might be established to advantage, and it is hoped that the means will be allowed at no distant time for doing so; but nothing has been done during the year in this connection, although the facilities of operations at several of the old stations have been greatly enlarged.

The suggestion has been made, through Mr. Livingston Stone, by the inspector of fisheries of British Columbia, that a joint hatchery should be started by the two Governments, for the purpose of increasing the supply of the Columbia River catch, and of introducing the Columbia River salmon into the Fraser River. Nothing, however, has been done in this connection. A hatchery within the United States on the Columbia River itself has also been proposed and zealously urged, as also a station in Colorado or elsewhere in the Rocky Mountain region to develop the possibility of cultivating the Rocky Mountain trout (*Salmo purpuratus*).

There is a great demand also for additional stations for the propagation of shad, which, like those just mentioned, will receive due consideration whenever practicable. In the foot-notes will be found some letters of interest which bear upon this general subject.

4.—VESSELS OF THE UNITED STATES FISH COMMISSION.

A.—THE STEAMER ALBATROSS.

The steamer Albatross, under the direction of Lieut.-Commander Z. L. Tanner, U. S. Navy, continues to work very satisfactorily in connection with the objects of the Commission.

Her services as a fishing vessel not being required during the winter, a request from the Navy Department that she be employed in hydrographic work in the Caribbean Sea was considered and approved, with the agreement that all the expenses of the voyage were to be met by the Department and the vessel returned to the Commission at the Washington navy-yard exactly in the same condition as when she left; and with the understanding also that a reasonable amount of time should be devoted to the prosecution of deep-sea research. The steamer proceeded accordingly from Washington to the Norfolk navy-yard, sailing thence direct for Saint Thomas on the 10th of January, 1884, arriving there on the 17th; starting again on January 24, a series of soundings was commenced, to extend from Santa Cruz to Porto Rico, as also to the Aves

VICTORIA, B. C., *January 19, 1884.*

DEAR SIR: Your kind favors of December 17 concerning lobsters, &c., and also one of January 9 in regard to salmon hatching trays, are to hand, for which please accept my thanks for your valuable information. I shall be most happy to write Mr. Redcliff on the subject.

The inspector of fisheries spoke to me to-day about the matter of establishing a joint hatchery on the headwaters of the Columbia River, in order to increase the supply of the Columbia River catch and introduce the Columbia River salmon into the Fraser River. I should think the matter could easily be arranged, as the Shuswap Lake and the north branch of the Columbia River are only 25 miles distant *via* Eagle Pass. This will be a short distance to carry fry when once the railroad is completed.

The Governments would have to arrange this matter, and I think it would be an advantage on both sides to have it done.

Yours very respectfully,

THOMAS MOWAT.

LIVINGSTON STONE, Esq.

SENATE CHAMBER, *Washington, D. C., February 5, 1884.*

SIR: I beg leave to ask your favorable consideration of a suggestion that you send a vessel to Florida during the present month and establish, at such place as shall be best suited, a station for hatching shad, in some of the waters of Florida. This is the spawning season, and

Islands, which were reached on the 27th. Boca Grande was visited on the 30th.

On February 3 the steamer proceeded to the Gulf of Paria, and thence to Curaçao. In this vicinity soundings were taken at the express request of the governor. The vessel next proceeded to Santiago de Cuba, which was reached on February 26, and Kingston, Jamaica, on March 2. Here some necessary repairs were made, and an additional supply of sounding weights taken on board. Leaving Kingston on March 11, Savanilla was reached on the 16th, and Aspinwall on the 26th, where on landing was made, on account of the prevalence of yellow fever.

The vessel then started homeward by way of Old Providence Island, where some interesting observations and collections were made. She arrived at Key West on April 15, and was delayed until the 27th for repairs. She then proceeded to Washington by the way of Havana, and arrived at the Washington navy-yard on May 16th. Extensive repairs to boilers were found necessary, and in accordance with the arrangement with the Navy Department the steamer was put in thorough order at its expense.

the opinion generally prevails that the fish hatched in the southern waters are better adapted to that part of the United States.

This is a subject of general interest to the people of the Southern States, and I respectfully suggest that the interest of this industry will be greatly promoted if such a station can be established immediately.

Respectfully,

HON. SPENCER F. BAIRD.

WILKINSON CALL.

Public resolution No. 35.

JOINT RESOLUTION authorizing the Secretary of War to lease certain lands to the board of fish commissioners of the State of Michigan.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War is directed and hereby duly authorized to lease to the State board of fish commissioners of the State of Michigan the parcel or strip of land lying north of and adjoining the Saint Mary's Falls Ship-Canal, and between said canal and the rapids of the Saint Mary's River, in the county of Chippewa and State of Michigan, including such portion of the lands reserved for the use of the canal as are not now needed for canal purposes, upon condition that the premises so leased are to be used solely by said commissioners for the culture and propagation of food-fishes and the residence of the employees of the commission, and that the use of said premises by them shall in no way interfere with the use of the same lands for canal purposes whenever required by the United States Government. The Secretary of War is requested to cause the removal of all persons now occupying any part of the said premises on or before July first, anno Domini eighteen hundred and eighty-four. The lease to said commissioners shall be rent free, and the buildings to be erected by said commissioners shall be first approved by the engineer officer in charge of the canal.

Approved June 26, 1884.

On July 13 she went to sea to investigate the migrations of the menhaden and mackerel from the capes of the Chesapeake to the Gulf of Maine, and reached Wood's Holl, Mass., on July 26. In August a number of dredging and exploring trips were made from Wood's Holl. During the summer the Secretary of the Navy, Hon. W. E. Chandler, made application for the use of the vessel for a few days at Newport, during a review of the vessels of the North Atlantic squadron and an inspection of the torpedo practice by the President and other public officials, which was granted. In September numerous trips were made to the fishing grounds for the purpose of studying their character, and on October 8 the vessel proceeded to New York, and thence to Washington, where she arrived on the 23d.

Congress having authorized and ordered an exhibition by the U. S. Fish Commission at the International Exposition at New Orleans, it was determined to make the Albatross one of the features of display on that occasion, and to combine with it a research into the fisheries of the Gulf of Mexico. The vessel having been properly refitted and supplied with coal left Washington on the 24th of December, 1884. The details of her winter cruise, and of her presentation at the New Orleans Exposition, will be found in the report for the year 1885.

Accompanying the appended report by Captain Tanner of the work of the Albatross for the year 1884 will be found full details as to list of officers and specialists on board and of her several exploring trips.

B.—THE STEAMER FISH HAWK.

With a view to ascertain whether anything could be done to increase shad in the Southern rivers by transferring the hatching operations to those rivers, this vessel was ordered early in the year to make a reconnaissance of certain streams in South Carolina and Florida. She left Washington on March 8 and proceeded to the Saint Mary's River, arriving at King's Ferry, Fla., March 10. After visiting Fernandina on the 31st, and touching at Savannah and Charleston, a landing was made at Georgetown, S. C., and the fisheries of Winyaw Bay were examined, and the vessel returned to Washington the 10th of April. Reports of the results obtained by Lieutenant Wood have already been published in the Bulletin for 1884, pages 140, 241, and 242. Lieutenant Wood expressed the opinion that these waters afforded little encouragement for artificial propagation. From April 24 to April 28 the Fish Hawk was engaged in a cruise of investigation in the lower part of Chesapeake Bay to ascertain the character of the fisheries for shad, herring, &c. An account of this trip will be found in the Fish Commission Bulletin for 1884, page 199.

From the 1st of May to the 27th the vessel was occupied in shad hatching on the Upper Potomac and located near Bryant's Point. From June 23 to July 7 she was engaged in transporting supplies from Washington to Saint Jerome and Battery Stations.

On the 9th of July the vessel proceeded from Washington to Wood's Holl with freight for that station, and thereafter, during the remainder of July and August, made dredging trips from Wood's Holl. Aid was also rendered to the officers and crew of the U. S. S. Tallapoosa, which sunk in Vineyard Sound August 22. On the 14th of October the Fish Hawk was loaded with freight to be returned to Washington. On the way some lobsters were obtained in New York for transfer to the mouth of the Chesapeake. Sixty-three of these were deposited off Back River light on October 19, an account of which transaction will be found in the Fish Commission Bulletin for 1885, page 31. The vessel reached Washington on October 20. During the greater part of November the Fish Hawk was engaged in investigating the oyster-beds of Chesapeake Bay, under the direction of Mr. T. B. Ferguson. On December 31, 1884, Lieutenant Wood was relieved from duty in the Fish Commission, and the command of the vessel, then at the navy-yard in Washington, was transferred to ensign L. W. Piepmeyer, U. S. Navy.

C.—THE STEAMER LOOKOUT.

On the 1st of January, 1884, Mate James A. Smith, U. S. Navy, was detached from duty with the U. S. Fish Commission steamer Fish Hawk, and ordered to the command of the Lookout. Mr. Smith at once took charge of the repairs and alterations which had been commenced in the fall for the purpose of better adapting the vessel for the special work of propagation and investigation, to which she would be assigned.

The steamer left the ways on April 30, and on May 17 a short trial trip was made down the river as far as Fort Washington. During the latter part of May and throughout the month of June the steamer was run between Washington, Saint Jerome, and Battery Stations, transferring launches, seine-boats, and other freight, from station to station, as needed. On June 27 the Lookout was ordered to Saint Jerome Station for the purpose of prosecuting certain work in conjunction with the steamer Fish Hawk, which was then on the ground.

In order to complete the tests of the different forms of propellers, for which the vessel had been placed at the disposal of the Bureau of Steam Engineering, a second board of engineers was appointed by the chief of the Bureau, and on July 3 additional experiments were made, the steamer making three round trips between Giesboro' Point and Marshall Hall. These trials were supplemented on August 5 by further tests with a still different form of propeller, which had been placed on the vessel in the mean time. A very complete and interesting report of the results of the various experiments has been published by the Bureau of Steam Engineering.

From the 10th to the 30th of July the Lookout was employed in the neighborhood of Crisfield, Cherrystone, and Hampton Roads in procuring information as to the catch of Spanish mackerel, &c., and in conducting experiments as to their artificial propagation.

On the 30th, through the courtesy of the Treasury Department, the vessel was examined by the local inspector at Norfolk. After some service in the neighborhood of Saint Jerome Station, the Lookout was ordered to the Delaware Bay for the purpose of continuing the Spanish mackerel investigations, but having broken her propeller off Chincoteague, was compelled to return to Norfolk, in which vicinity she was detained until the latter part of August, unfortunately too late for the mackerel spawning season in the Delaware. The vessel was thence transferred to the Wood's Holl Station.

Shortly after her arrival, on application of Mr. E. G. Blackford, one of the fish commissioners of New York, she was detailed for service with that commission to enable it to make some investigations as to the condition of the oyster-beds in Long Island Sound. From there she was transferred to the Great South Bay, where an investigation of the marine fauna was being conducted under the supervision of Dr. Tarleton H. Bean. On the completion of these assignments by October 8, the Lookout returned to Wood's Holl and was used to transfer the launch and small boat from that station to Battery Station, at Havre de Grace.

During the month of November she was used in the transfer of equipment between Battery and Saint Jerome Stations and in the investigations of the oyster-beds of Tangier Sound and the Chesapeake Bay in the neighborhood of Point Lookout.

On the Lookout's return from Washington to Baltimore she rescued the disabled schooner American Coaster off Annapolis and towed her to Baltimore.

During the month of November the vessel was used in towing lumber, coal, &c., from Havre de Grace to Battery Station, until work was discontinued on account of the closing of navigation in the upper bay by ice. On the 23d of December the Lookout was transferred from Battery Station to Baltimore, and there fitted out for a trip to the Southern Atlantic and Gulf coasts.

D.—ASSIGNMENTS OF NAVAL OFFICERS.

The list of changes in the assignment of naval officers connected with the service of the Fish Commission, either on vessels or on shore, has been as follows :

On February 6 Passed Assistant Engineer W. L. Bailie was detached from the Fish Hawk and ordered to shore duty at Wood's Holl, Mass.; and on the 8th of February Passed Assistant Engineer I. S. K. Reeves was ordered to the Fish Hawk.

On March 6 Ensign L. W. Piepmeyer was detailed from the Tallapoosa and sent to the Fish Hawk as first officer.

On June 18 Surgeon O. G. Herndon was relieved from duty with the Albatross and Surgeon J. M. Flint ordered in his stead.

On July 24 Lieut. William C. Babcock, who had been on the staff of the Commission for some time, was detached and ordered to the Lackawanna at Panama.

Lieut. Francis Winslow, who had also been on special duty with the Commission, was detached on August 17.

On December 31 Lieut. W. M. Wood, commanding the Fish Hawk, was detached, and Ensign Piepmeyer placed temporarily in command.

E.—OTHER VESSELS.

For some time past the importance of having a vessel constructed specially for transporting living fish, such as cod, halibut, &c., from the fishing grounds to the Wood's Holl or other shore station, where the eggs could be obtained and properly fertilized, has been manifest, and Capt. J. W. Collins, of the Fish Commission, was requested to prepare plans for this purpose. He has devoted several years to this investigation, and during his visits as an officer of the Commission to the fisheries exhibitions at Berlin in 1880 and at London in 1883, paid special attention to the problem, studying the features of construction of the fishing vessels, particularly of England and Holland, and furnishing some important ideas which have been embodied in the plans and specifications prepared under his direction. An appropriation of \$14,000, the estimated cost of the vessel, has been asked for from Congress, and it is to be hoped will be granted. As soon as the money is available bids will be invited and contracts entered into for the completion of the vessel at the earliest possible time. The details of this vessel will probably be given in the report for the year 1885.

The supply of small boats for the service of the Commission has been kept up at the different stations as occasion required. Among these is a catboat for communication between Havre de Grace and Battery Station.

5.—CARS.

The two cars arranged for and built within the last few years for the transportation of eggs and young fish, were reinforced during 1884 by another of admirable construction, in which the lessons of the first two were applied. An appropriation of \$8,500 was made by Congress, and with this the car was built and equipped. The uses to which it has been placed will be fully detailed in a subsequent part of this report.

6.—COURTESIES EXTENDED TO THE UNITED STATES FISH COMMISSION.

A.—BY THE GOVERNMENT.

TREASURY DEPARTMENT.—*Secretary's Office*.—Assistant Secretary H. F. French, on March 10, issued instructions to custom-house officers

at Boston and New York to admit fish and eggs free of duty from foreign countries, and to afford every facility for the prompt and careful transfer of these fish to the shore.

Light-House Board.—The Light-House Board, on March 19, granted to the Commission the use of a room in the light-keeper's house at Battery Station; on April 28 it authorized the further use of the storage building at Wood's Holl, previously occupied by the Commission, and on June 2 granted permission to take specimens of sea-lions from the Farallon Islands. The Board has also continued to assist in taking ocean temperature observations at about thirty-six of the light-houses and light-ships most favorably located.

Coast Survey.—The frequent calls upon the Coast Survey for tide-tables, maps, and charts required for the use of the different vessels of the Fish Commission have always been promptly complied with.

Life-Saving Service.—The arrangement made by the Superintendent of the Life-Saving Service for the telegraphic announcement to the Smithsonian Institution of the stranding of marine animals, has continued to be productive of important results, and the specimens obtained have proved to be most valuable.

WAR DEPARTMENT.—The Hon. Secretary of War, Robert T. Lincoln, granted authority to occupy the fishing-shore at Fort Washington, for the purpose of shad hatching, with the permission to use one of the buildings at the fort as headquarters for the men.

Signal Office.—General Hazen kindly furnished weather indications by telegram to Wood's Holl during the summer season. He also replaced several broken thermometers for the use of light-house keepers in taking temperature observations.

NAVY DEPARTMENT.—The officers and crews of all the vessels of the Fish Commission have been furnished by the Navy Department during the year, and all the facilities of the navy-yards, particularly that at Washington, have been extended to the Commission. The Boston navy-yard also lent to the Wood's Holl Station many needed tools.

Bureau of Construction and Repair.—The chief of the Bureau authorized the use of an unfinished launch, which was completed and used by the Commission in shad work on the Potomac River.

Bureau of Steam Engineering.—On March 13 Commodore Charles H. Loring granted the loan of a steam-launch boiler and engine for the use of the uncompleted launch referred to above.

Bureau of Equipment and Recruiting.—Coal was furnished the Fish Commission vessels by navy-yards upon requisition, as in the preceding year.

INTERIOR DEPARTMENT.—*Patent Office.*—The Commissioner of Patents has supplied the Fish Commission with the Official Gazette and other information with reference to patents relating to fish and fishing apparatus.

POST-OFFICE DEPARTMENT.—In December a daily mail was substituted for a semi-weekly mail to Baird, Cal., from Redding, by order of George M. Sweeny, Acting Second Assistant Postmaster-General.

SENATE AND HOUSE OF REPRESENTATIVES.—*Folding-Rooms*.—The superintendents of the Senate and House folding-rooms kindly consented to envelop the Fish Commission reports for 1881 as heretofore.

HEALTH OFFICE.—Statistics of the Washington fish-market have been furnished in monthly tables, which, after being compiled in the Fish Commission Office, were published in the Bulletin for 1885.

B.—BY THE RAILROADS OF THE UNITED STATES.

Since the introduction of transportation-cars the distribution of fish and eggs in the baggage-cars of the ordinary passenger trains has been largely given up, being now employed only for localities within a few miles of Washington or some other fish distributing center.

Many of the railroads in the United States have agreed to carry these cars on passenger trains for a small sum, generally not to exceed 20 cents per mile for the car and five messengers. A list of the principal roads charging 20 cents per mile or less will be found in the supplement.

While the greater part of this service was furnished at the rate of 20 cents per mile, not less than 8,176 miles of transportation were furnished entirely free of cost. This, at the rate mentioned, would amount to \$1,635.20.

C.—BY STEAMSHIP COMPANIES.

The foreign steamship companies have continued their usual liberal treatment of the Commission by the free transportation of fish and eggs, no charge having been made by them for the many sendings to Europe or for those received in return.

The shipments made through these agencies are shown under the following headings:

D.—COURTESIES FROM FOREIGN COUNTRIES.

Germany.—Another attempt to send blue carp from Germany was successfully made by Herr Max von dem Borne. On March 5th the steamship Werra left Bremen with 100 blue leather carp, of which number 45 arrived in New York on March 17. Mr. R. Hessel, superintendent of the carp ponds at Washington, met them in New York and immediately transported them to Washington. The fish, although weak on their arrival, were in a few days in good condition.

On February 15th 60,000 eggs of the German trout (*Salmo fario*) from Herr von Behr, were received and repacked by Fred Mather. Sixteen thousand were of the large variety, and 44,000 were of the small kind. Some of each were sent to Caledonia, N. Y., and to the Cold Spring Harbor, Northville, and Wytheville Stations.

December 10, 1884, Mr. Paul Matte, of Gross Lichterfelde, Prussia, sent to the Fish Commission, per steamer Werra, 5 specimens of macropods, or paradise fish, all of which died shortly after their arrival.

Great Britain.—On December 20, Sir James G. Maitland, Stirling, Scotland, sent 100,000 Loch Leven trout eggs by steamship Furnessia. They arrived in New York, January 2, in good condition. The National Fish Culture Association of Great Britain offered to assist the Fish Commission in obtaining turbot and sole.

There arrived at New York, by the White Star Line, on February 25, 10,000 German trout (*Salmo fario*), a present from R. B. Marston, editor of the Fishing Gazette, to the American Fish-Cultural Association. The eggs were taken charge of by Mr. Mather and forwarded to the Cold Spring Harbor hatchery.

7.—COURTESIES TO FOREIGN COUNTRIES.

During the present year the requests for fish and fish eggs from foreign countries have been granted where the proposed shipments were not impracticable or where the requests were not received too late in the season to send the kinds of fish and eggs desired. When such was the case a promise to send the following season was made. The countries receiving courtesies from the Commission are Belgium, France, Germany, Great Britain, Mexico, Netherlands, and New Zealand. Black bass, blue carp, catfish, golden ides, and leather and mirror carp, and the ova of brook trout, lake trout, landlocked salmon, rainbow trout, and whitefish have been furnished.

The condition of the fish and eggs on their arrival at the various points of destination can be seen by reference to the paragraphs devoted to the respective countries below.

Australia.—Under date of January 25 the Australian Fish Acclimatization Society at Ballarat, Australia, made a request for lake trout ova. The request, however, could not be granted, it being made too late in the season, but an offer was made to send a lot in the following December should they be desired then.

Belgium.—On November 15, 1884, ten cans, containing 100 catfish, were shipped by steamer Rhineland to Alfred Lefebvre, Ghent, Belgium. Under date of November 28, Mr. E. Williquet reported the safe arrival of 95 of the fish.

France.—Three thousand eggs of the rainbow trout were forwarded by steamer Normandie to the Société d'Acclimatation, Paris, France. Mr. C. Raveret-Wattel, secretary of the society, under date of May 18, reported that they arrived in "splendid condition."

Germany.—A shipment of 1,000,000 whitefish eggs, 25,000 brook trout eggs, and 25,000 lake trout eggs, all in good condition, was made on January 12, to Herr von Behr, president of the Deutsche Fischerei-Verein, Berlin, in the care of F. Busse, Geestemünde, by the North

German Lloyd steamer Neckar. A letter from Herr von Behr stated that the eggs arrived "in the most perfect state."

On March 20th, 12,000 eggs of the rainbow trout were received from the Northville Station, at Cold Spring Harbor, New York, where they were to be repacked for shipment to Germany. On unpacking the eggs it was found that they were too far advanced for shipment, many having already hatched on the way and died. These were exchanged for another lot, which, though not quite so far advanced, were rather old for shipment abroad. They were transported by a steamer of the North German Lloyd Line which sailed on March 29. These eggs did not arrive in good order, but Herr von Behr, who first wrote that he did not think a single egg would give a healthy fry, afterwards reported that they had done better than was first anticipated.

At the request of Max von dem Borne, of Berneuchen, 100 big-mouthed black bass (*Micropterus salmoides*) were shipped on March 26, by Bremen steamer, to the care of the Havre Aquarium at Havre, France. The bass, however, died *en route*.

Great Britain.—A shipment of 5,000 Schoodic salmon eggs was made to Sir James Gibson Maitland, Howietoun Fishery, Stirling, Scotland, by steamer Baltic, of the White Star Line, on the 8th of March. Under date of March 21, they were reported as having arrived on the 19th in "first-class condition," there being "only about twelve white eggs, ten of which were unimpregnated."

On the 14th of February a request for rainbow trout eggs was made by Hon. Edward Birkbeck, M. P., on behalf of the National Fish Culture Association, South Kensington, London, England. Accordingly, 3,000 eggs were forwarded on April 18, by steamer Assyrian Monarch, of the Monarch Line. The shipment did not meet with that success which usually attends shipments of eggs to Great Britain. Under date of May 15, Hon. Edward Birkbeck, M. P., vice-chairman of the association, announced that on the arrival of the steamer the eggs were found frozen through and killed. Fish eggs are usually placed in the provision room of the steamer, but on this occasion they were stored in the beef room, where the temperature was said to be from 35° to 40° F. If the eggs were frozen on their arrival in London, the temperature must have lowered considerably.

Mr. W. T. Silk was dispatched to America early in October, and commissioned to procure specimens of black bass, carp, and other species. On presenting his credentials, he was furnished by the Commission with 100 leather carp, 100 mirror carp, 20 blue carp, and 10 golden ides. Under date of Burghley, Stamford, England, November 25, Mr. Silk transmitted the thanks of the Marquis of Exeter, president of the National Fish Culture Association, for the fish presented by this Government.

In response to a request from Dr. Michael Beverley of Norwich, England, who was in attendance upon the Montreal meeting of the

British Association for the Advancement of Science, in September, 10 blue carp, 10 leather carp, and 10 golden ides were sent to his address in New York to be taken by him to England. On Dr. Beverley's arrival in England he reported that during the voyage the ides died, owing to decomposition of the water, in which plants had been placed for the purpose of purifying and aerating it. The water in which the carp were placed was changed and the plants removed, thereby insuring the safe arrival of the fish in England. These were planted in his pond on the 4th of October.

Mexico.—Reports of the Commission were furnished the Mexican Government in response to a request from the secretary of the board of public works, transmitted through the Mexican minister at Washington. Pamphlets on carp culture were also forwarded and a willingness expressed to supply the Mexican Government with fish as soon as the necessary preparations were made for their reception.

Netherlands.—In response to a request from Dr. C. Kerbert, manager of the aquarium of the Zoological Society of Amsterdam, for black bass, a lot of 18 was sent on June 3, 1884, by steamer Scheidam. A special apparatus to be used in the transportation of the bass was constructed, but owing to its large size, the captain of the steamer refused to take it on board. He, however, promised to provide all necessary room on the ship; and in large tanks and casks, which were provided, it was thought that the bass would reach Amsterdam alive. Under date of June 24 the bass were reported as dead on the arrival of the steamer.

New Zealand.—Mr. Frank N. Clark, of Michigan, accompanied the 1,000,000 whitefish ova for the Nelson Acclimatization Society as far as Omaha, Nebr., thus precluding delay of arrival at San Francisco. Mr. Robert W. J. Creighton, of San Francisco, announced the arrival of the ova in fine condition, and stated that they were safely packed in the ice-house of the steamer, which sailed at midnight on January 21. The ova were reported by Mr. Alfred Greenfield, secretary of the Nelson Acclimatization Society, as having arrived on the 11th of February. Ova from four of the nineteen trays were placed in the hatching boxes of the society. The following morning a large number were hatched. A large proportion of the eggs, however, were in bad condition, owing to delay at Auckland. The remaining fifteen trays were sent to an inland lake 54 miles distant, where two-thirds of the ova hatched. The young fish were reported as growing and as in a thriving condition.

8.—RESHIPMENT TO AND INSTALLATION IN THE NATIONAL MUSEUM OF THE EXHIBITS SENT FROM THE UNITED STATES TO THE INTERNATIONAL FISHERIES EXHIBITION IN LONDON, 1883.

The repacking and shipment of these exhibits to the United States were commenced immediately after the close of the exhibition in London on October 31, 1883, and the last car-load was received at the National

Museum early in the spring of 1884. The unpacking and installation of these collections, together with the new material obtained for the Museum from the collections of other countries at this exhibition, occupied a great deal of time in the early part of the year; and on the evening of May 14 the "fisheries section" of the National Museum was formally opened to the public. The building was illuminated by electric lights, gratuitously furnished for the occasion by the Brush-Swan Electric Light Company. During the evening an informal reception was held by the U. S. Fish Commissioner. The number of visitors on that occasion was two thousand and thirty-three. The Report of the National Museum for 1884 will contain a fuller account of the character of the collections.

Reception of medals.—Early in the year the medals, which had been awarded by the juries to American exhibitors, were received. These numbered one hundred and twenty-seven, and were distributed by the U. S. Fish Commission. Of this number fifty were gold, forty-seven silver, and thirty bronze.

Reception of diplomas.—These, one hundred and forty-two in number, were received late in the summer, and distributed in the same manner.

Special prizes.—Seven special prizes, amounting in value to £65 sterling, were awarded to United States exhibitors, and forwarded to them.

The special report required by Congress, treating of the exhibition in London and of the status of the fishery industries in Europe, is being prepared by Mr. G. Brown Goode, late commissioner to the exhibition, and will be ready for transmission to the Secretary of State during the coming year. There has, however, been already published a series of special catalogues, constituting a report upon the exhibit of the fisheries and fish-culture of the United States, made at the London Fisheries Exhibition. These catalogues, twelve in number, form Bulletin 27 of the U. S. National Museum. The first seven were printed separately in 1883. No. 8 appeared as a separate issue in 1884, and the last four appeared for the first time in the complete volume, which has been issued during the year. The following is a list of these catalogues:

A.—Preliminary catalogue and synopsis of the collections exhibited by the U. S. Fish Commission and by special exhibitors, with a concordance to the official classification of the exhibition.

B.—Collection of economic crustaceans, worms, echinoderms, and sponges. By Richard Rathbun, curator of the department of marine invertebrates in the U. S. National Museum.

C.—Catalogue of the aquatic and fish-eating birds exhibited by the U. S. National Museum. By Robert Ridgway, curator, department of birds, U. S. National Museum.

D.—Catalogue of the economic mollusca and the apparatus and appliances used in their capture and preparation for market, exhibited by the U. S. National Museum. By Lieut. Francis Winslow, U. S. Navy.

E.—The whale fishery and its appliances. By James Temple Brown, assistant in the department of art and industry, U. S. National Museum.

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F.—Catalogue of the collections of fishes exhibited by the U. S. National Museum. By Tarleton H. Bean, curator of the department of fishes in the U. S. National Museum.

G.—Descriptive catalogue of the collection illustrating the scientific investigation of the sea and fresh waters. By Richard Rathbun, curator of the department of marine invertebrates in the U. S. National Museum.

H.—Catalogue of the aquatic mammals exhibited by the U. S. National Museum. By Frederick W. True, curator of the department of mammals, U. S. National Museum.

I.—Catalogue of the collection illustrating the fishing vessels and boats, and their equipment; the economic condition of fishermen; anglers' outfits, &c. By Capt. J. W. Collins, assistant, U. S. Fish Commission.

J.—Catalogue of the apparatus for the capture of fish, exhibited by the U. S. National Museum. By R. Edward Earll, curator of the fisheries collections, U. S. National Museum.

K.—Catalogue of fishery products and of the apparatus used in their preparation. By A. Howard Clark, assistant in the department of art and industry, U. S. National Museum.

L.—Catalogue of the fish-cultural exhibit of the U. S. Fish Commission. By R. Edward Earll, curator of the fisheries collections, U. S. National Museum, and assistant, U. S. Fish Commission.

The great superiority of the exhibit made by the U. S. Fish Commission at this exhibition, and the profound impression which the explanations of its methods and purposes of fish-culture produced upon European fish-culturists, induced the Scottish fishery board to send to the United States Prof. J. Cossar Ewart, one of its members, for the purpose of becoming practically acquainted with the systems in use in this country.

Professor Ewart succeeded Sir Wyville Thompson, the scientific head of the Challenger expedition, as professor of zoology in the University of Edinburgh, and is himself highly distinguished as an investigator. Every facility was afforded Professor Ewart in the examination of the various stations of the U. S. Fish Commission, and the following letter was written by him just before leaving New York to return to Edinburgh. He expects to revisit the United States next year in time to study the operations in the hatching of shad and fresh-water herring.

Under date of New York, November 5, 1884, he says:

"I have just returned from visiting all the stations you suggested, with the exception of Northville. I feel very grateful for the facilities given me to study the work of the Fish Commission. From what I have seen I am convinced that Scotland in doing her little has done best to follow in your footsteps, and that although your Commission has accomplished much already, it is in reality only beginning its work, a work which will be of immense national importance. There is no doubt that fish-culture has a splendid future if carried on, as it has been by your Commission, in a truly scientific spirit. When I saw Wood's Holl, with its great facilities, I felt that I might confidently return to Scotland and advise the board of fisheries to devote all the means at its disposal to improving by artificial means the sea fisheries. I am extremely grateful for your kindness, and for the courtesy extended to me by all the officers of the Commission and others it has been my privilege to meet."

9.—PARTICIPATION IN STATE AND INTERNATIONAL EXHIBITIONS IN 1884.

The Smithsonian Institution and the U. S. Fish Commission are called upon with increasing frequency to take part in great State and International Exhibitions, and it is quite evident that if this is kept up for any length of time a special and continuous service must be organized in connection with the National Museum for discharging the duties connected with these displays. The withdrawal of the services of the curators and assistants from their regular work in the Museum, for the preparation and display of collections outside of Washington, has greatly interfered with the work of the Museum, and has brought about a well-founded complaint of incompleteness and unsatisfactory presentation. The mandate of Congress, in ordering such participation, is necessarily imperative, however, and leaves no option.

The principal occasions of the kind referred to were the International Exhibition at Philadelphia in 1876, the fisheries exhibition at Berlin in 1880, and at London in 1883. Preparations of displays and their exhibition at the fairs at Louisville, Cincinnati, and the International Cotton Exhibition at New Orleans were also ordered; and it may reasonably be assumed that during the year practically one-half of the time of the Museum assistants has been required in connection with these subjects, rather than with the regular work of the Museum.

On all these occasions the National Museum and the Fish Commission have made satisfactory exhibitions, and were generally conceded to be among the best shown.

A fair proportion of medals and diplomas have been received in past years, and during 1884 the directors of the Cincinnati exhibition awarded a gold medal to the Smithsonian Institution and a silver medal to the Department of Mineralogy.

The exhibitions at Cincinnati and Louisville are closed, and the collections were either forwarded direct to New Orleans for exhibition there or returned to Washington. The New Orleans Exposition opened on the 16th day of December, although but little material was in its proper place. Great efforts, however, are being made by the administration and the exhibitors, and it is probable that everything will be in place and in running order in the course of the month of January.

10.—MEETING OF THE AMERICAN FISH-CULTURAL ASSOCIATION.

The thirteenth annual meeting of the American Fish-Cultural Association was held in the lecture room of the U. S. National Museum on May 13, 14, and 15, 1884. After the meeting was called to order the minutes of the last annual meeting were read, and the financial state of the treasury of the association favorably reported upon. During the progress of the meeting, thirty names of gentlemen were proposed for membership and elected. The first paper was read by Mr. Fred Mather, on "Fresh-water and Salt-water Hatching at Cold

Spring Harbor," in which an account was given of the work carried on there in 1883 by the United States and New York State Fish Commissions. This was followed by a paper entitled "Salt as an Agent for the Destruction of the Fish Fungus," by Prof. H. J. Rice, in which salt was preferred to asphalt, tar, or salicylic acid for the purpose indicated, having been used most successfully. Mr. Livingston Stone read a paper on "The Artificial Propagation of Salmon in the Columbia River Basin," in which the author urged very strongly the redoubled energies of fish-culturists in the propagation of salmon in that river. Dr. Tarleton H. Bean submitted a paper on "The Whitefishes of North America," in which it was stated that there were twelve recognizable species of this fish in North America. This was followed by "Notes on Landlocked Salmon," by Mr. Charles G. Atkins. This name included all those salmon of Eastern North America and Europe that passed their entire lives in fresh water. It was his opinion that these fish preferred deep water and a temperature of less than 70° Fahr.

Mr. E. G. Blackford read a paper entitled "Is Legislation Necessary for the Protection of the Ocean Fisheries?" Mr. Blackford was of the opinion that restrictive legislation would result in cutting off a large amount of cheap food from the people. He hoped, however, that Congress would take some action providing for the regular collection of fishery statistics. This was followed by a paper upon "The Florida Sponge Fishery," by Mr. Joseph Willcox. A valuable contribution entitled "Notes pertaining to Fish-Culture" was submitted by Mr. James Annin, jr., who, however, was unable to be present at the meeting. In his paper was recorded a very interesting experiment (made by himself with eggs from a healthy brook trout, impregnated by several fine males of the same species), the result of which was that of 350 eggs which had been placed for less than a minute in the spawning pan, only 6 were impregnated; of 350 eggs which remained for three minutes, 31 were impregnated; while of 350 eggs which were allowed to remain in the spawning pan for thirty minutes, 208 were impregnated. Mr. John Murdoch read a paper on "Fish and Fishing at Point Barrow, Alaska." Three species of whitefish, *Coregonus lauretta*, *Coregonus kennicotti*, and *Coregonus nelsonii*; burbot, *Lota maculosa*; polar cod, *Boreogadus saida*; a species of salmon, *Oncorhynchus gorbusha*; the Pacific red-spotted trout, *Salvelinus malma*; and the smelt, *Osmerus dentex*, were enumerated as objects of the fisheries. The fishery was for the most part carried on by women and children by means of "jigs" let down through holes made in the ice.

A paper was then read by Dr. James A. Henshall, on the "Comparative Excellence of Food-Fishes." In this paper the flavor only was considered, and not the nutritive qualities of the fish. For his purpose, he divided fish into four groups, fresh-water, anadromous, estuary, and marine, placing the following species at the head of each group, respectively, whitefish, salmon, pompano, and Spanish mackerel.

The members of the association then visited the National Carp Ponds. In the evening an address was delivered by Hon. Theodore Lyman, of Massachusetts, in the lecture room of the National Museum, Hon. Elbridge G. Lapham in the chair. The speaker reviewed the ancient fisheries of the world, and dwelt upon the development of fish-culture in the United States. Hon. S. S. Cox followed in his usual humorous vein. Votes of thanks were proposed, and the meeting adjourned until the next day.

On Wednesday morning Dr. William M. Hudson read a paper on "The Shell Fisheries of Connecticut," in which he explained the gradual progress of the oyster industry in that State, and expressed his desire for further State legislation for the protection of the oyster cultivators. Then followed a paper on "The Oyster Industry of the World," by Prof. G. Brown Goode, wherein an approximation of the oyster-catch of the world assigned 5,572,000,000 oysters to North America and 2,331,200,000 to Europe for the year 1882. Col. Marshall McDonald read a paper on "Natural Causes Influencing the Movements of Fish in Rivers." He believed that our river fisheries must be restored and maintained (1) by artificial propagation; (2) by the extension of the breeding and feeding areas to their natural limits; (3) by a sufficient supply of proper food, where, through man's agency, this has been diminished or destroyed; and (4) by rational protective legislation. The influence of the temperature of the water upon the movements of fish was also discussed.

At the afternoon session the following gentlemen were elected as officers of the association:

President, Hon. Theodore Lyman, M. C.

Vice-president, Col. Marshall McDonald.

Treasurer, Hon. E. G. Blackford.

Corresponding secretary, Mr. R. E. Earll.

Recording secretary, Mr. Fred Mather.

Members of the executive committee:

Mr. James Benkard.

Mr. George Shepard Page.

Mr. Barnet Phillips.

Prof. G. Brown Goode.

Dr. William M. Hudson.

Mr. S. G. Worth.

Prof. W. O. Atwater then read a very elaborate paper on "The Chemical Composition and Nutritive Value of our American Food-Fishes and Invertebrates." Three tables accompanied this paper: Table I showed the percentages of water and nutritive ingredients in the edible portion of fishes and invertebrates; Table II gave the percentages of refuse, water, and nutritive ingredients in specimens of food-fishes and invertebrates as found in the markets; Table III presented the constituents of certain vegetable foods and beverages. The comparative cost of

protein in fish and other animal and vegetable foods was also calculated.

Mr. John A. Ryder followed with a paper "On the Forces which determine the survival of fish embryos." He enunciated the principle that just in proportion as the individuals of a species are prolific in respect to the number of their germs, just in that proportion do the chances of survival of the individual germs seem to be diminished, and *vice versa*, and that this natural fecundity, or the want of it, is dependent upon the amount of protection received by the eggs in the course of development. On Thursday, May 15, the first paper was read by Mr. Richard Rathbun, entitled "Notes on the Decrease of Lobsters." Mr. Rathbun urged a thorough investigation of all points bearing upon the natural history of the species, upon the changes which have occurred in the fishery grounds, and upon the relations of the total catch for each section to the number of fishermen and traps, and the average size of the lobster taken. Mr. S. G. Worth then read a paper on "The Propagation of the Striped Bass." This was followed by a paper on the "Result of the Introduction of Gill-nets into the American Cod Fisheries" by Capt. J. W. Collins. It was his opinion that a very important step had been attained through the efforts of the U. S. Fish Commission in perfecting the method of cod gill-netting, which had been in use in American waters about five years. At 11 a. m. the members of the association went to the White House, and were introduced to President Arthur. At noon a meeting of the State fish commissioners convened in the office of the assistant director of the National Museum. The cultivation of oysters and shad was discussed, and the advice and assistance of the U. S. Fish Commissioner sought on various matters pertaining to the fisheries.

At 1 p. m. the members of the association proceeded to the Lower Cedar Point wharf, where they embarked on board the Fish Hawk, which had been tendered by the Commission for a trip to one of the shad stations on the Potomac. During the trip a meeting was held in the interest of oyster cultivation. The name of the association was also changed to "The American Fisheries Society," and twenty-one foreign gentlemen were elected corresponding members of the society.

11.—PUBLICATIONS IN 1884.

Reports.—The report for 1881 (Vol. IX) was nearly all in type at the beginning of the year. The composition was completed April 1, and the edition of bound volumes received for distribution in June.

The report for 1882 (Vol. X) was taken in hand early in the present year and pushed forward so vigorously that on the 24th of July it was all in type, and by the last of October the bound volumes were ready for distribution. A small pamphlet edition of the report proper was printed and distributed in conformity with previous practice.

The report for 1883 (Vol. XI) was commenced late in the year, and by December 31 about one-half of it was in type.

Bulletins.—The bulletin for 1883, the editorial work of which had been completed in that year, was put through the press and bindery in January and February. Bound volumes were received February 23 of the present year.

The bulletin for the current year (Vol. IV) was commenced early in the year, the first signatures being distributed May 3. Subsequent instalments were sent out August 21, September 19, October 24, and November 15. At the latter date the entire volume for the year was in type. On the 31st of December a stitched copy of the volume was received from the printer.

Pamphlets.—So great has been the demand for publications of the Commission that it has been impossible to give bound copies to all who desired them. This difficulty is, however, obviated to some considerable extent by the issuing of separate papers in pamphlet form. During the current year the following were issued:

65. BAIRD, SPENCER F. Report of the Commissioner for 1881. A.—Inquiry into the decrease of food-fishes. B.—The propagation of food-fishes in the waters of the United States.
[From Report for 1881, pp. xiii-lxxi.]
66. SMILEY, CHARLES W. Special Bulletin: (1) Notes on the edible qualities of German carp and hints about cooking them; (2) The German carp and its introduction in the United States.
[From Bulletin for 1883, pp. 305-336.]
67. RYDER, JOHN A. Rearing oysters from artificially fertilized eggs, together with notes on pond culture, &c.
[From Bulletin for 1883, pp. 281-294.]
68. WEBSTER, H. E., and JAMES E. BENEDICT. The *Annelida chaetopoda* from Provincetown and Wellfleet, Massachusetts.
[From Report for 1881, pp. 690-747.]
69. RATHBUN, RICHARD. Descriptive catalogue of the collection illustrating the scientific investigation of the sea and fresh waters.
[London Exhibition, part G, pp. 169.]
70. TANNER, Z. L. Report on the construction and work in 1880 of the Fish Commission steamer Fish Hawk.
[From Report for 1881, pp. 3-53.]
71. RYDER, JOHN A. A contribution to the embryography of osseous fishes, with special reference to the development of the Cod (*Gadus morrhua*).
[From Report for 1882, pp. 455-603.]
72. McDONALD, MARSHALL. Report submitting plans and specifications of the fishways for the Great Falls of the Potomac River. P. 22.
73. BAIRD, G. W. Annual report on the electric lighting of the United States Fish Commission steamer Albatross, December 31, 1883.
[From Bulletin for 1884, pp. 153-158.]
74. TRUE, FREDERICK W. Catalogue of the aquatic mammals exhibited by the United States National Museum.
[London Exhibition, part H, pp. 22.]

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75. GOODE, G. BROWN. The status of the U. S. Fish Commission in 1884. A review of what has been accomplished in fish-culture and the investigation of the American fisheries.
[From Report for 1884, pp. 1139-1184.]
76. RYDER, JOHN A. On the preservation of embryonic materials and small organisms, together with hints upon imbedding and mounting sections serially.
[From Report for 1882, pp. 607-629.]
77. BAIRD, SPENCER F. Report of the Commissioner for 1882. A.—Inquiry into the decrease of food-fishes. B.—The propagation of food-fishes in the waters of the United States.
[From Report for 1882, pp. xvii-xciii.]
78. SMITH, SIDNEY I. Report on the decapod crustacea of the Albatross dredgings off the east coast of the United States in 1883.
[From Report for 1882, pp. 345-426.]
79. TANNER, Z. L. Report on the work of the U. S. Fish Commission steamer Fish Hawk, for the year ending December 31, 1882, and on the construction of the steamer Albatross.
[From Report for 1882, pp. 3-34.]
80. McDONALD, MARSHALL. A new system of fishway building.
[From Report for 1882, pp. 43-52.]
81. COLLINS, J. W. History of the tile-fish.
[From Report for 1882, pp. 237-294 a.]
82. COLLINS, J. W. Notes on the habits and methods of capture of various species of sea-birds that occur on the fishing banks off the eastern coast of North America, and which are used as bait for catching codfish by New England fishermen.
[From Report for 1882, pp. 311-338.]
83. VERRILL, A. E. Notice of the remarkable marine fauna occupying the outer banks off the southern coast of New England, and of some additions to the fauna of Vineyard Sound.
[From Report for 1882, pp. 641-660.]
84. VERRILL, A. E. Physical characters of the portion of the continental border beneath the Gulf Stream explored by the Fish Hawk, 1880 to 1882.
[From Report for 1882, pp. 1045-1057.]
85. SMILEY, CHARLES W. Report on the distribution of carp to July 1, 1881, from young reared in 1879 and 1880.
[From Report for 1882, pp. 943-1008.]
86. BEAN, TARLETON H. List of the fishes distributed by the U. S. Fish Commission.
[From Report for 1882, pp. 1039-1044.]
87. BEAN, TARLETON H. List of fishes collected by the U. S. Fish Commission at Wood's Holl, Mass., during the summer of 1881.
[From Report for 1882, pp. 339-344.]
88. SMILEY, CHARLES W. The influence of artificial propagation upon production illustrated by the salmon work of the Sacramento River, California.
[From Bulletin for 1884, pp. 201, 202.]
89. TRUE, FREDERICK W. Suggestions to the keepers of the United States life-saving stations, light-houses, and light-ships, and to other observers, relative to the best means of collecting and preserving specimens of whales and porpoises.
[From Report for 1883, pp. 1157-1182.]

Carp publications.—During the year several editions of "The carp and its culture in rivers and lakes," by Rudolph Hessel, and of "Carp and carp ponds" have been printed and distributed to the numerous persons making inquiries about carp.

Mr. Charles W. Smiley, chief of the division of records, during the year has had entire charge of the preparation of all matter for the printer, the correcting of the proofs of text and plates, and all else relating to the proper presentation of the several volumes, pamphlets, and circulars, as well as of their distribution to correspondents and applicants.

12.—THE WOOD'S HOLL STATION.

The importance of a station on the sea-coast, where the researches of the Commission into the ocean fisheries, the distribution and migrations of the fish, the character of their food, and all their associations, could best be prosecuted, has frequently been presented in the pages of the reports of the Commission, and reasons have been given at length from time to time why Wood's Holl, on the south coast of New England, and the extreme southwesternmost land of Cape Cod, had been selected. The report for 1883 furnishes a full statement of the measures taken to acquire a suitable locality, and the fact indicated that a suitable quantity of land was purchased by friends of science and presented to the United States, on condition of being used for the purpose in question; and this was supplemented by the donation by Mr. Joseph S. Fay of a large extension of the same water front. Also, that the title to the land was found by the Attorney-General of the United States to be satisfactory; and that the State of Massachusetts, under the administration of Governor Long, had ceded the necessary jurisdiction to the United States. The schedule of the buildings necessary for the work of the Commission was indicated, and the fact stated that two of the most important ones had been finished.

I now have to report that, Congress having made the necessary appropriation for the purpose, the erection of the laboratory building, an edifice 120 × 40 feet, has been begun and partly finished during the year; leaving for 1885 the construction of the coal shed and of a storage building, which it is hoped will be accomplished in 1885.

Owing to the fact that the foundations of the laboratory building had to be erected on mud, mostly covered at high water, unusual expenditures were required to secure a suitable foundation, making the cost considerably more than would otherwise have been the case. The natural difficulties, however, were overcome, and the superstructure was under roof by the end of the year.

Concurrently with the work on the Fish Commission building the construction of the adjacent harbor of refuge under the direction of Col. George H. Elliot, of the U. S. Engineers, and based upon an appropria-

tion in the river and harbor bill, was prosecuted, and the larger part of the stone work completed in the year. This, with the wooden wharves, when finished, will furnish every possible convenience for the work of the Commission, as well as answering the general needs of a harbor of refuge.

It is proposed to make Wood's Holl the general station for the vessels of the Commission, not only during the summer, but at other times when they are to be laid up; and where the necessary repairs can be made to the vessels by their own machinists, and thus a large amount saved to the appropriation.

The steam power required for the pumping of the water in the water-tower has been arranged to work a number of machine tools kindly lent by the Navy Department from the unused machinery of the Boston navy-yard, including lathes, planers, &c., thus aiding greatly in the facilities for repairs just mentioned.

Two artificial ponds for the propagation of the oyster were built under the direction of John A. Ryder on ground belonging to Dr. J. H. Kidder and Camillus Kidder kindly granted for the purpose. It is thought that much important experience will here be gained for the use of oyster culturists in general.

The western portion of the eel pond, immediately adjacent to the oyster pond in question, was granted by the selectmen of Falmouth to Mr. Joseph S. Fay, with the understanding that it was to be used for the experimental work of the Commission.

As in previous years at the various summer stations of the Commission, in addition to the specialists officially connected with its service, a number of naturalists visited the station for the purpose of utilizing the opportunities of research. Such specialists are always cordially welcomed, and every facility given them for the prosecution of their labors.

During the season, other visits were received from several eminent English men of science; among them Sir Lyon Playfair; Prof. Adam Sedgwick, of Cambridge; Prof. H. N. Moseley, of Oxford; Professor Hedden, of Dublin; and Prof. J. Cossar Ewart, of Edinburgh. They appeared to be much interested in the arrangements of the station, and on their return home made very eulogistic mention of what they had seen at Wood's Holl, and of the general plans and results of the work of the Commission.

As usual, the biological summer work, and especially that connected with the marine invertebrates, was prosecuted under the direction of Prof. A. E. Verrill, assisted by Prof. S. I. Smith.

The exploration of the Gulf Stream region was continued this season, under nearly the same conditions as in 1883, by the steamer Albatross, Lieut.-Commander Z. L. Tanner commanding. During the four trips, between July 20 and September 13, sixty-nine dredgings (at stations

2170 to 2238) were made. In most of these a large beam-trawl was used very successfully, even at great depths.

Of these dredgings five were in depths between 2,000 and 2,600 fathoms (four successful), twenty were between 1,000 and 2,000 fathoms, twenty-four between 500 and 1,000 fathoms, eight between 300 and 500 fathoms, and twelve between 75 and 300 fathoms. Another trip has since been made to explore extensively the zone between 40 and 100 fathoms. On this trip about twenty-four additional dredgings were made, but the results are not yet worked out. The first trip was made while the steamer was on her way north from Norfolk, Va., and some of those stations were off the coast of Maryland, the most southern being in north latitude $37^{\circ} 57'$, but most of the others have been made in the region south and southeast of Martha's Vineyard, although several were a long way off the coast. The five stations in depths below 2,000 fathoms were more than half way to Bermuda, and nearly east of the coast of Virginia, between north latitude $36^{\circ} 05' 30''$ and $37^{\circ} 48' 30''$; and between west longitude $68^{\circ} 21'$ and $71^{\circ} 55'$.

The results are highly satisfactory, both in physical observations and zoological discoveries. Large numbers of additions have been made to the fauna, including representatives of nearly all classes of deep-sea animals. Many pelagic species were also secured in the surface nets, and especially in the trawlings. Among these there are some new forms, and many that have not previously been observed so far north in the Gulf Stream.

The most important economical application anticipated for the Wood's Holl Station is the propagation of codfish, under charge of Capt. H. C. Chester, the superintendent of the station. The first take of eggs was on November 14, and amounted to 3,000,000. These were treated, and many important facts ascertained in regard to their development. Unfortunately the work of dredging in the vicinity of the stone pier for the purpose of giving a proper depth for navigation kept the water in a turbid condition during all the time that the eggs of the cod were being hatched and militated very seriously against full success, a small percentage only of the fish being obtained. These, however, were planted in the vicinity. It is hoped that by another year these drawbacks will have passed away and that there will be nothing more to prevent the full realization of all my anticipations on this point.

13.—INVESTIGATIONS IN LONG ISLAND SOUND.

It is well known that the shallow waters adjacent to Long Island Sound, especially those of Great South Bay, abound in a great variety of fish, the flats becoming greatly warmed during the summer season

* It is but just to say that the unusual thoroughness and remarkable success of these explorations of the Gulf Stream region have been due to the great skill and untiring zeal and energy of Captain Tanner, who has personally superintended all our deep-sea dredging operations during the past five years. It is also proper to add that his efforts have been well supported by the other officers associated with him.

and constituting an acceptable abode for the young fish. It was from these waters, in great part, that Mr. J. Carson Brevoort, the eminent ichthyologist of Brooklyn, N. Y., derived most of his material, which he has kindly presented to the Smithsonian Institution.

In response to repeated suggestions from gentlemen specially interested in the subject, it was considered expedient to cause a careful examination to be made of the different kinds of fish occurring in these waters, and Dr. T. H. Bean was accordingly detailed for the purpose.

On September 30 Dr. Bean wrote from Patchogue as follows:

"We have enjoyed a highly gratifying day of collecting, and our list of species now foots up 53. The Lookout has helped us to increase our store by the addition of 14 species since it came in. The weather so far has been propitious and everybody seems satisfied. I am sorry that we did not secure the aid of the steamer much earlier, as we hoped to do. However, there are several accessions now of which I feel somewhat proud. We seined two examples of *Fistularia* to-day, besides a species of *Hemirhombus* (or *Platophrys*), and numerous examples of the ovate pompano *Trachymotus ovatus*. *Bairdiella* is quite common throughout the bay; so, also, is *Synodus fætens*. Two species of anchovy occur—one of them very abundant—in the eastern portion of the bay, and the other not moving so far from the ocean inlet; everywhere these little fishes attract the bluefish, squeteague, silver gar, and other predaceous species. The silver sides (*Menidia notata*) are excessively abundant everywhere, and serve as food for the bluefish. I have been somewhat astonished to find one of the hakes (*Phycis tenuis*) well distributed in the bay, associated with the tomcod. The tomcod is much infested, in some places, with a lernæan parasite. *Gobiosoma* is very common. The tautog we find in greater numbers as we approach the inlet, and the same is true of the cunner. Young weakfish (squeteague) are universal, except in shoal water. Kingfish (*Menticirrhus nebulosus*) are sufficiently numerous wherever we seine, but the young, from 1½ to 2½ inches or more in length, were taken in the surf to-day in larger numbers than I have seen before. The scup and the squeteague form the principal catch of the 7 pounds near the Fire Island light. Young sea-bass are much more abundant at Wood's Holl than we find them here. The white perch, a comparatively recent arrival in Great South Bay, is becoming gradually distributed, but we have not yet caught a single example in our seines. *Synodus fætens* is a very common species here, reaching all parts of the bay visited by our nets. We do not find young menhaden, and the only clupeoids secured are an occasional half-grown menhaden, one hickory shad (*Clupea mediocris*) and one alewife (*C. vernalis*, probably). The big-eyed cel is one of our treasures."

14.—ICELAND HALIBUT FISHERY.

In the spring of this year three Gloucester fishing schooners made trips to the coast of Iceland to obtain flitched halibut and halibut fins. The flitched halibut are cured by smoking, and the fins are pickled. This is the first occasion of American fishermen visiting these grounds, and is somewhat noteworthy as the result of the interchange of views at the London Exhibition between our representatives and the Europeans. On his return from the London Exhibition, Captain Collins com-

municated to the Gloucester fishermen information relative to the localities, and as a result the vessels Alice M. Williams, Captain Pendleton; Concord, Captain Dago, and David A. Story, Captain Ryan, were fitted up. Their success was in every way satisfactory, and will probably lead to the continuance of the industry. A full account of the trips, obtained by Captain Collins from the vessels' logs and by conference with the masters, will be found in the appendix.

15.—INVESTIGATIONS OF THE SHAD FISHERIES OF FLORIDA, GEORGIA,
AND SOUTH CAROLINA.

For the purpose of ascertaining the actual abundance of spawning shad in the Florida waters, with a view of establishing hatching stations, should the prospect be favorable, Mr. William Hamlen, one of the most experienced fish culturists of the Commission, proceeded to Florida, reaching Jacksonville on March 1, where he found very few fish, and received the impression that they had diminished so greatly in the Saint John's River as to indicate an impending exhaustion of the stock. He then went to the Saint Mary's River, where he found a larger supply of fish; and on March 4 obtained 13 ripe females from which 240,000 eggs were secured, but very little show for obtaining results of sufficient magnitude to warrant further effort. The same experience was encountered in the Satilla River, the diminution being equally marked as in the Saint Mary's.

Thinking it possible that the apparatus used by the fishermen in these rivers was not suitable for taking spawning fish, the steamer Fish Hawk, under command of Lieut. W. M. Wood, U. S. Navy, was ordered to Florida, and reached King's Ferry, on the Saint Mary's, on March 19. Nothing of any moment was accomplished, and the vessel returned to Washington. It was concluded that the best place for taking shad, for the purpose of artificial propagation, was the Saint Mary's River, between King's Ferry and the Brick Yard; and that if the logs in the river could be removed it was likely that enough shad could be taken for the purpose of artificial propagation.

Returning to Washington in the Fish Hawk, Lieutenant Wood stopped at Georgetown, S. C., for the purpose of investigating the fisheries in that locality. He found that the capture of fish is prosecuted entirely by gill-nets, and that very few ripe or spawning fish are taken, which, of course, would be quite natural in view of the saltness of the water.

16.—INVESTIGATION OF THE FISHERIES FOR WHITEFISH IN THE
GREAT LAKES.

Desirous of ascertaining whether the artificial propagation of whitefish had made a perceptible increase, or, at least, prevented a diminution of the catch of the species within the last few years, Mr. Frank

N. Clark was instructed to visit as many of the stations on Lake Erie as possible, and to report the results of his inquiry.

The total number of young fish deposited by the U. S. Fish Commission, and the Ohio and Michigan fish commissions, amounted, from the spring of 1875 to the spring of 1882, to about 82,000,000; half of which were planted in 1881 and 1882, and would not enter into the number of fish taken.

Mr. Clark found it very difficult to come to any precise conclusion as to the ratio of abundance now and in earlier years, as the constant increase from year to year in the number of nets tends to make up for the diminished proportion of capture by each net. As the general result of the inquiry, Mr. Clark is decidedly of opinion that not only has the decrease been arrested, but that there has been a tangible and satisfactory increase, taking all conditions into consideration.

It is now proposed to collect systematically the statistics of the fisheries of the Great Lakes in 1885, and to show, by comparison with corresponding figures made by the census of 1880, more accurately what the change has been, whether for the better or the worse.

17.—MORTALITY OF FISH.

The occurrence of extended mortality among the fish, both of the fresh waters and of the sea, has been a subject of much interest, and the attention of the Commission has been specially attracted to the determination at least of the causes, even though they be so general in their action as to be apparently incapable of cure.

Several accounts have been given of the occurrence, at short intervals, of fish pestilences in the Gulf of Mexico, where for weeks at a time, in particular regions, the surface will be found covered with dead or dying fish of all kinds that inhabit the waters. Thousands of tons are estimated to be thus destroyed. Nothing satisfactory has yet been indicated as to the origin of this difficulty. The fish themselves do not appear to be diseased in any way. A correspondent of the Commission, however, has suggested that, owing to some unusual condition, the cold waters of the deeper parts of the Gulf are brought near to the surface, where they affect these fish, the sudden chill producing such a shock as to cause either death or temporary disturbance of health. The waters in which these occurrences take place are said sometimes to be discolored as if by the presence of microscopic forms of either animals or plants; and it is not impossible that a careful search, prosecuted by an expert on the spot, may solve the problem.

Mr. Philo Dunning, of the Wisconsin fish commission, called the attention of the U. S. Fish Commission to a fish pestilence in the Madison lakes during the summer, the perch especially suffering. It was thought that not less than 200 tons of dead fish came ashore, which were buried by the selectmen for the sake of preventing a pestilence. Every year there is more or less of this trouble, though not always re-

sulting in so great destruction. Various causes have been assigned in explanation of this mortality, some finding it in the parasitic leeches that are swallowed by the fish and which attach themselves to the intestines with fatal results, others to lack of oxygen in the water as a consequence of the intense heating of the shallow waters.

Desirous of settling this matter in the best possible manner, I requested Prof. S. A. Forbes, of Champaign, Ill., one of the most eminent biologists in the West, to proceed to Wisconsin and give personal attention to this subject. He unfortunately arrived after the close of the mortality, and was unable to ascertain anything definite on the subject. He, however, made preparations of the viscera of a number of the dead fish, and to his great surprise found that all thus affected gave evidence of the presence in the liver, spleen, and other organs, of innumerable micrococci. He has not yet determined whether this was the cause of the disease or its accompaniment, but proposes to continue the investigation.

B.—INQUIRY INTO THE HISTORY AND STATISTICS OF FOOD-FISHES.

18.—THE WORK OF THE FISHERY CENSUS OF 1880 AND ITS RESULTS.

In my report for 1882, pp. xliii-li, is given a brief account of the results of the joint investigation of the fisheries of the United States, undertaken in co-operation with the Superintendent of the Tenth Census. It was stated that a division of the material had been agreed upon, and that the manuscript of the report prepared for the census was already in his hands. Two years have passed since that time, and nothing has been accomplished by the Census Office toward the printing of this report, which being in the main statistical, is fast losing part of its value. Colonel Seaton, the present Superintendent of the Census, having requested that this manuscript, which he is unable to print, be so far as possible published in the report of the Fish Commission, he has returned a portion of the same, which will soon be put in the printer's hands, so as to form a section of the special quarto report ordered by Congress.

Progress in printing the quarto Fisheries Report.—The special quarto report upon "The Food-Fishes and Fisheries of the United States," ordered printed in 1882, is slowly being put in type, about 1,200 pages being already completed and a large number of illustrations engraved. The first section, devoted to the natural history of useful aquatic animals of the United States, with an atlas of 277 plates, has been entirely finished for some months, and its publication is awaiting the convenience of the Public Printer. The other parts of the report are ready, and it is hoped that in 1885 a great deal of progress will be made. The contents of the entire report will be, approximately, as follows :

XLIV REPORT OF COMMISSIONER OF FISH AND FISHERIES.

THE FOOD-FISHES AND FISHERY INDUSTRIES OF THE UNITED STATES.

Introduction, including a general review of the fisheries and a statistical summary.

- PART**
- I.—The natural history of useful aquatic animals.
 - II.—The fishing grounds.
 - III.—The fishing towns, containing a geographical review of the coast, river, and lake fisheries.
 - IV.—The fishermen.
 - V.—The apparatus of the fisheries, and fishing vessels and boats.
 - VI.—The fishery industries, a discussion of methods and history.
 - VII.—The preparation of fishery products.
 - VIII.—Fish-culture, fishery laws, and fishery legislation.
 - IX.—Statistics of production, exportation, and importation. Summary tables.
 - X.—The whale fishery—a special monograph.
 - XI.—A list of books and papers relating to the fisheries of the United States.

Section II, "Fishing Grounds of North America," was also completed during the year, excepting the index, which will be ready in a few weeks. This section consists of VII + 144 pages, and will be accompanied by 17 maps.

19.—THE BLACK COD OF THE PACIFIC.

The value of the black cod of the North Pacific Ocean and the expectation of its coming value as an element of the American fisheries was dwelt upon in the preceding report. An elaborate report on this fish, prepared by Mr. James G. Swan, of Port Townsend, Washington Territory, will be found in the Bulletin of the Fish Commission for 1885, page 225. Nothing further has been done during the year in the way of developing the fishery or in introducing it into commerce.

20.—USE OF THE COD GILL-NETS.

It will be remembered that a few years ago the U. S. Fish Commission succeeded in inducing the fishermen of the east coast of Massachusetts to use the gill-nets with glass-ball floats, as employed by the Norwegians in the capture of the winter or spawning cod. At the present time the number of vessels using gill-nets exclusively is increasing, and at the same time the total yield of the fisheries; probably half, if not more, of all the fish taken now in the cod fisheries of New England are captured with the gill-net.

At the suggestion of Mr. Swan, of Port Townsend, the Commission furnished several cod gill-nets to parties working in Puget Sound, for the purpose of determining their availability in that locality. Unfortunately the rapid tide and the lack of skill in the use of the nets, caused them to drift on the rocks in the deep water and be lost.

The only drawback to the more extended use of gill-nets for the taking of cod and other sea fish consists in the rapidity with which the twine rots, probably owing to the amount of mucous rubbed off from the fish. In some cases it is necessary to supply a new set every four or five weeks.

As the total cost of nets used at the present time on the New England coast amounts to about \$40,000 for the winter, the tax upon production is a very serious one. Various processes for the treatment of nets have lately been indicated and are now employed by the fishermen, some of them with apparent success, and it is to be hoped that the difficulty in question will soon disappear.

21.—INVESTIGATION OF THE OYSTER FISHERIES OF THE NEW YORK WATERS.

Investigations of the condition and availability of the oyster-beds of the State of New York have been in progress for some years under the direction of Mr. E. G. Blackford, one of its fish commissioners, and at his request the steamer Lookout was detailed for use in his explorations. The vessel was occupied for nearly two weeks in September in this connection, and the general results will shortly be published by Mr. Blackford in the reports of the State fish commission.

22.—LAW OF CONGRESS IN REGARD TO THE FISHERIES OF THE DISTRICT OF COLUMBIA.

The rapid decrease in the value of the fisheries of the Potomac River, especially of the shad, has induced some public-spirited citizens of Washington to take up the subject with a view of getting such Congressional legislation as might be necessary to secure the requisite measure of protection; and, after considerable debate, a law was passed which makes it illegal to use any form of net in the Potomac River within the District of Columbia for five years after the passage of the act.

CHAP. 316.—AN ACT to protect the fish in the Potomac River in the District of Columbia, and to provide a spawning ground for shad and herring in the said Potomac River.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That from and after date of passage of this act, for a term of five years, it shall not be lawful to fish with fyke-net, pound-net, stake-net, weir, float-net, gill-net, haul-seine, or any other contrivance, stationary or floating, in the waters of the Potomac River within the District of Columbia.

SEC. 2. That any person who shall offend against any of the provisions of this act shall be deemed guilty of a misdemeanor, and upon sufficient proof thereof in the police court or other court of the District of Columbia, shall be punished by a fine of not less than ten dollars nor more than one hundred dollars for each and every such offense, and shall forfeit to the District his nets, bouts, and all other apparatus and appliances used in violation of law, which shall be sold, and the proceeds of such sales, and all fines accruing under this act, shall be paid into the Treasury: *Provided,* That nothing in this act shall be construed to prohibit angling or fishing with the out-line, or to prevent the United States Commissioner of Fish and Fisheries, or his agents, from taking from said waters of the Potomac River, in the District of Columbia, in any manner desired, fish of any kind for scientific purposes, or for the purposes of propagation.

SEC. 3. That from and after three months from the date of the passage of this act it shall be unlawful to allow any tar, oil, ammoniacal liquor, or other waste products

of any gas-works, or of works engaged in using such products, or any waste product whatever of any mechanical, chemical, manufacturing, or refining establishment to flow into or be deposited in Rock Creek or the Potomac River or any of its tributaries within the District of Columbia or into any pipe or conduit leading to the same, and any one guilty of violating this section shall, on conviction, as provided in section 2 of this act, be fined not less than ten dollars nor more than one hundred dollars for each and every day during which said violation shall continue, to be prosecuted for and recovered as provided in the preceding section.

Approved March 2, 1885.

As there is every probability that the law will be enforced, so far, at least, as the use of nets is concerned, the experiment will furnish a fair test as to the utility of such protective measures. The law also prohibits the introduction of poisonous refuse of gas-works or other manufactories. The experiment of the protection of the broad waters of the Potomac referred to, will not probably be of much benefit unless strict measures are taken to prevent the discharges complained of. The incidental objections, aside from the injury to the fish, to the discharge of this oily or tarry matter consist of its foulness, and the extent to which it attaches itself to boats of all kinds, especially those belonging to the numerous Washington boating clubs.

C.—THE INCREASE OF FOOD-FISHES.

23.—BY PROTECTIVE MEASURES.

The idea is widely entertained that the U. S. Fish Commission has received from Congress some authority for enforcing measures looking towards the prevention of improper modes or times of capturing fish in American waters, and it is somewhat difficult to satisfy inquirers that the functions of the Commission are purely advisory, and do not include the power of either making or enforcing regulations. Its advice on such subjects, when asked, is, however, freely given. The only enactments by Congress on this subject thus far are those relating to the protection of fish in the waters in the District of Columbia.

In response to a request from the Board of Health of the District of Columbia, I directed Col. M. McDonald to make an investigation and report in reference to the pollution of the Potomac River in the limits of the District by the discharge into it of the waste products from the manufacture of illuminating gas.

The examination showed that a large amount of matter, presumably deleterious, is discharged into the river from the works of the Washington and Georgetown Gas Companies, the most serious source of pollution being the dark oily residuum coming from the regenerators employed in the establishment for the manufacture of gas from oil, this being used as an enricher of the gas from coal. The physical characteristics of this substance are such as must determine its general distribution

over the bed of the river in front of Georgetown and in lessening quantity as far down as the limits of the District extend. Its general distribution over the bed of the river may, and doubtless does, affect unfavorably the conditions of life for all those minute forms of life which have their nidus on the bottom, and which furnish the food of forms alike minute, which float or swim in the water above, and which afford appropriate sustenance to the young shad, herring, striped bass, &c. The pollution of the water may not exert a direct effect in driving the larger fish from the river, yet indirectly, by modifying unfavorably the conditions of life at the bottom, may, by destroying their food, render impossible the development and growth of the embryo fish, which must be nurtured in this area in numbers sufficient to compensate the annual drain made by the river fisheries.

In connection with the legislation now pending to limit or restrict net fishing in the District waters, it is deemed important to prohibit the discharge of waste products from the gas factories into the river, and I have so advised the Board of Health. The measures of legislation proposed and pending, if enacted into law, will doubtless exert an important conservative influence upon the shad and herring fisheries of the Potomac.

24.—SPECIES OF FISH CULTIVATED AND DISTRIBUTED IN 1884.

The species of fish and invertebrates receiving the attention of the Commission during the year, with the exception of the addition of a few of more or less interest, are the same as heretofore. Work has been prosecuted on a large scale in regard to only a few species; those receiving special attention, in addition to the several varieties of *Salmonidae*, are the shad, the carp, and the goldfish. The scale of the operations on which the work has been conducted has, however, in many cases been much greater than heretofore; not only a larger number having been hatched out, but the area of distribution greatly extended.

The following is a list of the species included :

- a. The Codfish (*Gadus morrhua*).
- b. The Rockfish or Striped Bass (*Roccus lineatus*).
- c. The Whitefish (*Coregonus clupeiformis*).
- d. The Moranke (*Coregonus albula*).
- e. The Grayling (*Thymallus tricolor*).
- f. The Brook Trout (*Salvelinus fontinalis*).
- g. The Lake Trout (*Salvelinus namaycush*).
- h. The Saibling (*Salmo salvelinus*).
- i. The California, Rainbow, or Mountain Trout (*Salmo irideus*).
- j. The Atlantic or Penobscot Salmon (*Salmo salar*).
- k. The Schoodic or Landlocked Salmon (*Salmo salar* subsp. *sebago*).
- l. The Brown or European Trout (*Salmo fario*).
- m. The Loch Leven Trout (*Salmo leuensis*).
- n. The Quinuat or California Salmon (*Oncorhynchus chonicha*).
- o. The Shad (*Clupea sapidissima*).
- p. The River Herring (*Pomolobus aestivalis*).

- q. **The Carp** (*Cyprinus carpio*).
- r. **The Goldfish** (*Carassius auratus*).
- s. **The Golden Ide or Orf** (*Leuciscus idus*).
- t. **The Tench** (*Tinca vulgaris*).
- u. **The Catfish** (*Amiurus nebulosus*).
- v. **The Clam** (*Mya arenaria*).
- w. **The Oyster** (*Ostrea virginica*).
- x. **The American Lobster** (*Homarus americanus*).

a. **The Codfish** (*Gadus morrhua*).

The Wood's Holl Station.—The preparations for the hatching of codfish at Wood's Holl were not finished sufficiently in season to permit the work to be done on an extensive scale; but enough of experimental work was carried on at the station, under the direction of Capt. H. C. Chester, its superintendent, to give abundant promise of excellent results in the future. It is expected that, with the completion of the preparations, another winter will witness the successful progress of the work on a very large scale.

The construction of a schooner containing a well for the transportation of live fish will add greatly to the success of the work. Much of the anticipated result will depend upon the ability to obtain breeding fish in sufficient quantity to keep the apparatus in full activity, and it is hoped that Congress will make the necessary appropriations for such a vessel.

b. **The Rockfish or Striped Bass** (*Morone saxatilis*).

The Weldon (North Carolina) Station.—The greatly increased catch of small rock by the introduction of pound-net fishing in our rivers and fresh-water sounds indicates the necessity at an early day of making provision to compensate by artificial propagation for the drain upon the supply.

The experimental work conducted during the present season at Weldon, N. C., jointly by the U. S. Fish Commission and the North Carolina Commission of Fisheries, under the direction of S. G. Worth, superintendent, assures us that we now have at our command the methods and apparatus necessary to handle successfully this class of eggs whenever it is necessary to resort to artificial propagation in order to maintain or increase the supply.

The interesting report of Mr. Worth, which will be found in the Bulletin for 1884, pages 225-228, gives full details of the organization and conduct of the work, the method and apparatus employed, and the results attained. The total number of impregnated eggs obtained was only 2,420,000, but by occupying the station at the beginning of the season and providing suitable facilities for collecting the spawn, it is probable that eggs can be obtained in any number desired. The apparatus employed was the automatic jar now in general use in the shad work, the manipulation of the eggs being difficult, however, on account of the greater buoyancy of the eggs of the striped bass. The pro-

portion of eggs incubated which hatched was 52 per cent and the number of fry planted in the Roanoke at Weldon was 280,500.

c. **The Whitefish** (*Coregonus clupeaformis*).

The Northville Station.—The work at this station, which continued under the supervision of Mr. Frank N. Clark, was carried on much as during the previous year, but on a much more extensive scale. The propagation of whitefish is the principal object of the station, and this work being greatly increased, a corresponding increase in the facilities for handling the eggs and young fish was required. The equipments of the hatchery were rearranged, more hatching-jars were introduced, several additional tanks were placed in a building near the hatchery, and an elevated reservoir was constructed from which the hatching apparatus was kept amply supplied with water.

The winter of 1884-'85 was an extremely severe one in Northville; consequently the hatching period was several weeks later than usual, and the distribution of young fish, which generally begins about February 20, did not commence this year until April 1. The weather during the period for taking the eggs, November 13 to December 1, was very favorable most of the time on Lake Erie; but a severe storm on Lake Huron, November 6, seriously interrupted the work there. The summer and fall catch of whitefish in Lake Erie was much greater than for several seasons. This was largely due to the work of propagation carried on by the various fish commissions, as this lake was more largely planted than others with whitefish; and the fishermen are now becoming convinced of the practical value of such work.

The penning of whitefish was successfully carried on in the Raisin River, where the fish were kept in crates alongside the piers in the river, about one-quarter of a mile from Lake Erie. To these crates the fish were towed from the pound-nets in the lake in a "live-car," at the rate of about 5 miles an hour, always with safety to the fish. A heavy storm in the latter part of November blew so much of the water from the river that the fish had to be disposed of; but this circumstance is unprecedented, and not likely to occur again. The penned fish were handled very successfully. The first eggs were taken November 13, and the greatest number taken in one day was 750,000. The temperature of the water in the crates ranged from 36° to 46° Fahr. This plan of penning the fish was tried also at Alcona, on Lake Huron, with much promise of success should the place be fitted up properly for this purpose.

The shipments of whitefish eggs to various States and to foreign countries were much larger than before and generally very successful, the losses being almost nothing. During the shipping season, which lasted from December 24 to March 10, 31,000,000 eggs were furnished by Northville. Two million were sent to the Deutsche Fischerei-Verein of Germany, half of which were lost because of bad handling

on the steamer; 500,000 to Switzerland, where their safe arrival was reported by Col. Emil Frey, Swiss minister to the United States; 250,000 to the National Fish Culture Association of England, which reached their destination in excellent condition; 1,000,000 to Australia, which, after reaching Sydney in good condition, were nearly all lost in transferring them to Melbourne; 1,750,000 to the New Orleans Exposition; and the remainder were distributed among seven States and Territories, and to the U. S. Fish Commission at Washington.

The distribution of the young fish was not so successful relatively as before, as the fish had been too crowded at the hatchery, owing to the lateness of the hatching season, and were consequently weak. On experiment, also, it was found that large and open cans are safer for large shipments of fry than smaller and closed cans. From Northville fifty million fish were planted, largely in Lake Michigan and adjacent waters.

Somewhat extensive operations were carried on at this station in lake trout, brook trout, rainbow trout, grayling, and Loch Leven trout, which are spoken of under their proper heads.

The Alpena Station.—Much that has been said about success, &c., at the Northville station applies also to this station.

No eggs were distributed from Alpena, but 38,000,000 fish were successfully hatched and planted, chiefly in Lake Huron.

The eggs from these two stations came from the fisheries of Lakes Erie and Huron and the north shore of Lake Michigan, 103,000,000 coming from Lake Erie alone. In all, 155,000,000 were received; 31,000,000 were shipped away, and 88,000,000 hatched and planted.

The Cold Spring Harbor Station.—In 1883, 1,000,000 eggs were received from the Northville station and hatched with a loss of only 4 per cent, and 600,000 fry were planted in ponds near Riverhead and Cold Spring Harbor.

In 1884, there were received also 1,000,000 eggs, of which number 400,000 fry were planted in Great Pond, near Riverhead, 375,000 in Lake Ronkonkoma, near the center of Long Island, and 75,000 in a mill-pond at Cold Spring Harbor.

Central Station.—In December, 1884, or about the first of January, 1885, two shipments of 1,000,000 eggs each were received from the Northville station in excellent condition.

These produced 1,775,000 fry, which were disposed of as follows:

Sent to the Fish-Cultural Exhibit, New Orleans Exposition.....	200,000
Planted in Potomac River at Sir John's Run	1,250,000
Planted in Potomac River at Great Cacapon	325,000
Total	1,775,000

d. The Moranke (Coregonus albula).

This fish is held in very high esteem in Germany, in consequence of which Herr von Behr wrote on the 25th of December that he would send 50,000 eggs to New York for the United States Fish Commission. He

states that it is a fine fish, occupying deep lakes in the north of Germany, and grows to a weight of 1½ pounds. It is never found in German lakes of less depth than 50 feet, and never in running water. It feeds on small crustaceans, worms, and mussels, coming to the surface only at night, especially warm summer nights. In early winter it spawns in shallow water, generally performing this act during the night. Each female bears from 2,000 to 5,000 eggs, which sink to the bottom and adhere to aquatic plants. It is usually caught in large numbers with nets and seines, and brought to the market either fresh or smoked. It is highly esteemed on account of its delicate flavor.

c. The Grayling (Thymallus tricolor.)

The Northville Station.—The grayling is a famous game fish which seems to be steadily diminishing in number, hence it is necessary that measures be taken for its protection and propagation. The work of the past season was largely experimental, as there was no exact knowledge regarding the spawning habits of this fish. Many obstacles, also, had to be encountered and overcome, such as deep snow, swift currents, and the great number of logs that were being sent down the Manistee and Au Sable Rivers in Northern Michigan, from which the eggs were obtained; while the fish that furnished the spawn were caught by hook-and-line fishing. Twenty thousand eggs were received, and 5,000 were shipped to the Central Station at Washington, while nearly 12,000 were hatched, and those that lived were retained at the Northville Station for breeding purposes. The period of incubation was found to be from 14 to 20 days, with a water temperature ranging from 50° to 62° Fahr. The hatching was successful, about 75 per cent of the eggs hatching out; but fully 90 per cent of the fry died within a couple of weeks, as most of them refused to take food. The few hundred that lived grew rapidly, far exceeding the size of trout of the same age.

With the experience gained this season, the work of another season would doubtless be more successful. It is suggested, however, that a better way would be to catch the fish during the autumn, when the rivers are free from logs, and to keep them in a suitable place until their spawning time, which seems to be about the middle of April.

The Wytheville Station.—On May 1, 1885, 5,000 eggs of the grayling were received at the Wytheville Station. These were hatched and produced 4,075 young. Heavy mortality occurred after hatching, and on May 1, when the young were transferred from the hatching troughs to the rearing ponds, only 2,557 remained. These will be retained at the station and the attempt made to rear them in confinement.

f. The Brook Trout (Salvelinus fontinalis).

The Northville Station.—The eggs were obtained from the breeding stock at the Northville ponds, more being taken from fish two and one-half years old than from those of any other age. The first eggs were taken October 12, and the last January 5. In all 326,850 eggs were

obtained, and 170,000 were shipped away; 40,000 being sent to the Deutsche Fischerei-Verein, in Germany, where they arrived in good order; 25,000 to the National Fish Culture Association, of England, reaching there in excellent order; and the rest being distributed among nine States. Of the 20,000 fry obtained, 4,000 were kept at the station for breeding purposes, and the remainder were planted in various streams in Michigan.

The Cold Spring Harbor Station.—In 1883, 150,000 eggs of the brook trout were received from the Northville Station, which yielded 122,000 young fish for distribution.

In 1884, 6,000 eggs were handled, yielding 5,000 fry, which were planted at points on Long Island.

g. The Lake Trout (Salvelinus namaycush).

The Northville Station.—There was a greater supply of the eggs of this fish than usual, the larger proportion being obtained from runs of fish on the coast reefs of Lake Huron near Alpena. Formerly the fishermen objected to the eggs being taken if the young fish were to be returned to the Great Lakes, under the apprehension that they would prey upon the young of the whitefish; but now the increased prices obtained for these fish have influenced the fishermen to favor artificial propagation. There were received at Northville 465,000 eggs, all of which came in good condition. Of this number, 345,000 were shipped away; 30,000 being sent to the National Fish Culture Association, of England, which they reached in excellent condition; and 5,000 to the New Orleans Exposition, the rest being distributed among fish commissioners of various States; while 65,000 fry were hatched and planted in neighboring parts of Michigan and Indiana.

Central Station.—Sixty thousand lake trout eggs were received from the Northville Station on December 25, 1884, arriving in prime condition. They yielded for distribution 52,000 fry, which were planted in the Potomac River, at Sir John's Run, and in the Monocacy, at Frederick City Junction.

The Wytheville Station.—Forty thousand ova of the lake trout were received from Northville on January 30, 1885. These yielded 29,000 fry for distribution. A few hundred were retained for rearing in ponds, and the rest planted in Reed Creek, a tributary of New River, in Wythe County, Virginia, on April 16, after being fed for several weeks in the hatching troughs.

h. The Saibling (Salmo salvelinus).

Reference has been made in previous reports to the receipt of several lots of the saibling, their delivery in 1881, and their transfer for subsequent treatment to the fish commissioners of New Hampshire, at Plymouth. As already stated, they seem to take well to their new surroundings, and the first eggs were obtained on December 3, 1883. The New Hampshire commissioners continue their work with this fish, and,

by impregnating the eggs of brook trout with saibling milt, secure a hybrid which may possibly be of value. It is not thought that the saibling is superior in value to our own native fish, although experiments upon both the pure species and the hybrid will be continued.

i. **The California, Rainbow, or Mountain Trout** (*Salmo irideus*).

The McCloud River Station.—Mr. Livingston Stone retains the general supervision of this station, but Mr. Loren W. Green was immediately in charge. The spawning time seems to come a little later each year. This season it lasted from December 18, when 12,300 eggs were taken, to May 28, when 8,000 were obtained; and at this last date a number of the females had not yet spawned, though the spawning season for the males was entirely over. The eggs were slower in maturing in the fish than usual, were of inferior quality, and about 200 less in number to the fish than in former years. Much of this may be attributed to the scarcity of food in the river during the fall, as the food supply for the McCloud River was much diminished, owing to the blasting operations near the mouth of Pitt River (into which the McCloud empties) by the Central Pacific Railroad Company.

During the latter part of January a heavy fall of rain caused a rapid rise in the river, and a landslide on the creek which supplies the trout ponds made the water very muddy and killed 35,000 eggs in the hatching troughs, despite the utmost efforts to protect them.

Notwithstanding the difficulties experienced this year, 315,225 eggs were taken; of which number, 125,000 were sent to Washington, nearly 60,000 were lost, 35,000 were sent to Minnesota, Iowa, and Nebraska; some were hatched and returned to the McCloud River; and about 21,000 were hatched and the young fish kept at the station for breeding purposes.

The Northville Station.—There was a marked improvement in the quality of the eggs which were obtained from the breeding stock at the Northville ponds. In former years from 75 to 90 per cent of the eggs were lost, but this season more than half were good. As the breeding fish were fed much less than usual, this is thought to account for the improvement. The spawning season began on January 9, and ended April 24; and many of the later lots of eggs taken turned out as high as 90 per cent good. A few eggs were taken also from two-year-old trout, for the first time at this station.

During the season 111,100 eggs were obtained from 126 fish. The mortality during incubation was very large, only 47,500 eggs being available for distribution. Small allotments were sent to the Deutsche Fischerei-Verein (Germany), to the National Fish Culture Association (England), and to the Howietoun hatchery (Scotland), some to the New Orleans Exposition, and the rest were distributed to the fish commissioners of Iowa, Michigan, and Minnesota; and 12,000 fry were hatched and planted in a stream near Northville. The eggs sent to Germany

were not properly cared for on the passage, and were all lost. Those to England were duly received in good condition, hatched with a very low rate of mortality, and planted in the fish-culture establishment at Delaford Park; and those to Scotland arrived in good order.

The Cold Spring Harbor Station.—From four lots of eggs received in 1883, 75,000 eggs in all, only 26,200 fry were obtained. These were planted in various waters of New York. The number handled in 1884 was only 10,000, which were planted in streams near the station.

This is a fish that, for some reason, does not do well at this station. During the summer of 1884, though plentifully fed, they did not grow much, and they died in great numbers.

This species is a quick-growing fish and not very sensitive to warm water, and in these respects is superior to our brook trout.

Central Station.—One hundred and forty-seven thousand five hundred eggs of the rainbow trout were received from the McCloud River Station during the months of January, February, and March, 1885. The packages were opened, their condition ascertained, repacked, and the eggs distributed as follows:

To Wytheville Station	113,000
To the Fish-Cultural Exhibit, New Orleans Exposition	5,000
To the Maryland Commissioner of Fisheries	5,000
To Cold Spring Harbor Station, New York	22,500
To H. I. Pierce, Winsted, Conn	2,000
Total	147,500

No eggs of this species were hatched at Central Station during the season.

The Wytheville Station.—This station was first occupied in the winter of 1881-'82 with the object of establishing a center for the breeding and rearing of Salmonidæ for stocking the headwaters of those streams in Pennsylvania, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Tennessee, Georgia, and Alabama, which rise in the Appalachian region and flow into the Atlantic and the Gulf of Mexico.

A notable feature of the work of the year is the stocking of a number of the streams of the South Atlantic and Gulf Basins with two-year-old California trout. The California trout reared at the station from eggs brought from McCloud River, California, spawned for the first time in December, 1884.

With the close of the year, therefore, we have this station inaugurated as a producing as well as a hatching and distributing station. The fish-cultural work hereafter will be mainly directed to the breeding and rearing of the California trout for stocking Appalachian waters; and as it is not proposed to distribute the fry bred at the station until they are at least one year old, it will require a very extensive system of ponds to meet the requirements of the work. Detailed plans for these and for a new hatchery have been already perfected.

The total number of eggs incubated during the season was 161,000. Of these, 113,000 were obtained from the McCloud River Station, and 48,000 from breeders at the station, reared from eggs obtained in the winter of 1881-'82 from the California Station.

The number of young fish produced was 121,417, which was reduced by casualties of various kinds to 103,400 fish on May 1, when the fry were transferred from the hatching troughs to the ponds. It is not contemplated to distribute them until the late winter and spring of 1886, when they will have attained such size as to be comparatively safe from the attacks of other fish.

A large distribution of yearling California trout was made to streams in Pennsylvania and a number of streams and ponds in Virginia, Tennessee, Alabama, and Georgia.

The total distribution was as follows:

To streams in the vicinity of Philadelphia, Pa.....	fry..	1,500
To streams in Pennsylvania, distributed under direction of State commissioner	yearlings..	5,900
To streams in Western North Carolina.....	do.....	2,000
To Tato's Run, near hatchery.....	fry..	2,500
To Shenandoah River, Virginia	yearlings..	2,100
To Warrior River, Alabama.....	do.....	1,000
To Coosa River, Rome, Ga	do.....	1,000
To private ponds in Pennsylvania and Tennessee	do.....	250
Total		16,250

j. The Atlantic or Penobscot Salmon (*Salmo salar*).

The Bucksport Station.—Mr. Charles G. Atkins continues in charge of this station, the operations being conducted, as formerly, by the U. S., the Maine, and the Massachusetts Fish Commissions. The breeding salmon, as heretofore, were purchased from the Penobscot River fishermen, beginning on May 31 and ending on July 5. In all, 568 salmon were obtained, of which number 472 were placed alive in the inclosure of part of Dead Brook, 50 were turned into a large inclosure in Eastern River, and 46 died while being transported. In the autumn 393 were recaptured in Dead Brook, and 39 in the river, being about 83 per cent of all those deposited alive, and about 76 per cent of all those obtained. The fish were recaptured in Eastern River by means of traps of netting set at each end of the inclosure; and about the same number were taken at each point, thus seeming to indicate that salmon are as likely to descend as to ascend at the spawning season.

The fish at spawning were of much smaller size than those of 1883, averaging nearly 10 pounds in weight and being about 31½ inches in average length, but not differing much from the average of other years; 42 per cent were males, and 58 per cent females. In all, about 1,935,000 eggs were obtained, while during development about 119,000 were lost. Of the good eggs 78,000 were hatched on account of the U. S. Fish Commission, and the remainder, 1,730,000, were sent away. Shipments

were made during January and February of 1885 with the usual success; 30,000 were sent, through Mr. Fred Matber, of the Cold Spring Harbor Station, to England, where they were received by the National Fish Culture Association in excellent condition, the loss during transportation being less than 1 per cent.

The shares of the eggs allotted to the United States and to the various States interested are enumerated in Mr. Atkins's report in the Appendix.

The Cold Spring Harbor Station.—During the spring of 1883, 295,000 fry from this station were planted in the headwaters of the Hudson and Salmon Rivers, being the fish resulting from 350,000 eggs received from the Bucksport Station.

In 1884, 500,000 eggs were received from the Bucksport Station; and 448,700 fry were hatched, and 428,200 planted, mostly in the headwaters of the Hudson River.

Central Station.—On February 12, 1885, 10,000 eggs were sent from the Bucksport Station, and received in first-class condition. From these were produced 9,796 young, which were planted in Palmer River, Rhode Island, May 8, 1885.

k. The Schoodic or Landlocked Salmon (*Salmo salar* subsp. *sebago*).

The Grand Lake Stream Station.—The work at this station was very successful, showing a considerable gain over that of 1883. Mr. Charles G. Atkins continues in charge; but the work of the spawning season was by him turned over to Mr. H. H. Buck, with several experienced assistants. The fishing lasted from October 30 to November 22, and resulted in the capture of 1,186 fish, 808 being females and 378 males. There was a marked increase in size, as well as a gain in number, over the catch of 1883, as in 1884 the males averaged 4 pounds and the spawning females averaged 4.11 pounds in weight.

This station is jointly operated by the U. S. Fish Commission and the State commissions of Maine, Massachusetts, and New Hampshire, and the eggs obtained are allotted *pro rata* to the different parties contributing to the expenses of the station.

Total production of eggs for the season	1,820,810
Losses during incubation	254,410
Available for distribution	1,566,400
Hatched at the station and returned to Grand Lake Stream	397,400
Available for pro rata distribution	1,169,000

Which were allotted as follows:

To U. S. Fish Commission	608,000
To Maine Fish Commission	234,000
To Massachusetts Fish Commission	187,000
To New Hampshire Fish Commission	140,000
	<hr/> 1,169,000

Those allotted to the U. S. Fish Commission were assigned as follows:

To the Deutsche Fischerei-Verein, Germany	40,000
To the National Fish Culture Association, England	30,000
To Scotland, Tay Fishery Board and Howietoun hatchery	20,000
To Fish-Cultural Exhibit, New Orleans Exposition	5,000
To Central Station, Washington	10,000
To State commissioners and individual applications	503,000
	<hr/>
	608,000

In general, these eggs reached their destinations in good condition and were successfully hatched and planted. Full details regarding the fish caught, their size, and the shipments of eggs may be found in tables appended to the report of Mr. Atkins.

The Cold Spring Harbor Station.—In 1883 and 1884 there were received at this station 141,500 eggs of this fish from the Grand Lake Stream Station; and about 125,000 fry were distributed in various streams and ponds of New York.

Central Station.—March 24, 1885, 10,000 eggs were sent from the Grand Lake Stream Station, and received in excellent condition. These yielded 7,000 fry, which were disposed of as follows: Retained for the aquaria at Central Station, Washington, D. C., 2,000; planted in the Shenandoah River at Waynesborough, Va., 5,000.

1. **The Brown or European Trout** (*Salmo fario*).

The Cold Spring Harbor Station.—Early in 1883 a lot of eggs of this species was sent to Mr. Mather as a personal present by Herr von Behr, president of the Deutsche Fischerei-Verein. Most of those kept at this station died, but those sent to the Northville Station and to the station of the New York Fish Commission at Caledonia were reported as doing well. In 1884 Herr von Behr sent an additional gift, this time to the U. S. Fish Commission, in care of Mr. Mather, and a lot of 10,000 was received from England. These did better than those of 1883, and many were distributed to various New York waters.

On the 21st of February Mr. Mather forwarded to Washington 2,000 of the large kind of *Salmo fario* and 9,000 of the small variety. These were transferred to the Wytheville Station to be hatched.

It was found by experience that this fish has a strong tendency to leap out of the water when disturbed or when placed in new waters; and many died by jumping out on banks even 2 feet high, and remaining there to perish. This European brook trout has larger scales than our brook trout, and probably can be successfully acclimatized in the streams along our Atlantic coast.

The Wytheville Station.—Eleven thousand eggs of this species (2,000 of the large variety, and 9,000 of the small variety) were sent to this station from the Cold Spring Harbor Station, by way of Washington, in February, 1884. These were hatched with fair success, but all died before beginning to eat.

m. **The Loch Leven Trout** (*Salmo leuiscensis*).

The Northville Station.—One hundred thousand eggs of this species were received in excellent condition on January 7, 1885, from Scotland, having been sent by Sir James Gibson Maitland, of the Howietoun fishery, Stirlingshire, and repacked by Mr. Fred Mather, of Cold Spring Harbor, N. Y., by whom all shipments of eggs to and from Europe were skilfully and successfully handled. Fifty-five thousand of the eggs were distributed to the commissioners of New Hampshire, Iowa, Minnesota, and Maine. The loss of the eggs in hatching was very slight, and only a few of the fry died in the tanks. Of the 43,500 that were hatched at Northville, 36,500 were planted in various streams in Michigan, and 7,000 were retained at the hatchery for breeding purposes.

n. **The Quinnet or California Salmon** (*Oncorhynchus tshawytscha*).

Active operations at the McCloud River Salmon Station were suspended this year for reasons which will be found in Mr. Stone's report in the Appendix. The property of the Commission at this point was placed under the care of Mr. Robert Radcliff.

o. **The Shad** (*Clupea sapidissima*).

The Fort Washington Station.—This station was continued in charge of Lieut. William C. Babcock, U. S. Navy, under much the same general conditions as in 1883. A small frame house was built near the wharf as an office and to preserve the eggs from bad weather and it still remains as an improvement to the station. Arrangements were made early in the season with a gang of seine haulers to fish the seine on shares, giving the spawn taken to the Fish Commission, which furnished the outfit. Tent Landing, Chapman's Point, White House, and Ferry Landing were visited regularly during the season; and a number of gill-net fishermen also furnished eggs. The owner of Moxley's Point refused to allow the Commission to take spawn on his fishing-shore, as he expected a more liberal offer for the privilege. A steam-launch was furnished by the Navy Department. From April 9 to May 1 this launch made daily trips to the fishing-shores as far down as Chapman's Point, but this was found to be a severe task for so small a boat, and during May the Fish Hawk aided in this work.

The station was fitted for service on April 7, and the first eggs (45,000 in number) were taken on April 14, but the temperature of the water was too low for their successful development. About the middle of May severe rains and the resulting high water and currents disturbed the fishing considerably; but in general the conditions were more favorable than during the preceding season. On May 27, nothing having been caught for several days, the station was closed for the season, a total of 19,000,000 shad eggs having been taken. The seine hauled by the Fish Commission was successful, as it alone furnished 6,000,000 eggs, and supplied an abundance of fish for the food of the men. Experiments were tried in penning shad, with the same results as in 1883,

namely, that males can be kept for five or six days in good condition, but that females usually die after two or three days. Penning male shad towards the close of the season, when the gill-nets catch only females, may be advisable, and save many millions of eggs.

Herring were numerous about the station towards the middle of May, but after May 16 they disappeared. One lot of herring eggs (3,000,000 in number) was taken, but for some reason they failed to hatch.

Because of their former experience the men were more successful than before. Some valuable recommendations in regard to this station are found in Lieutenant Babcock's report.

Fish Hawk assistance.—On May 1 the steamer Fish Hawk, Lieut. W. M. Wood commanding, left the navy-yard at Washington for Fort Washington and vicinity to assist in the shad propagation.

From May 2 to May 26 the steam-launch visited Chapman's Point, Pomonkey, and other fisheries, from which were obtained about 3,000,000 shad eggs. About 800,000 of these were hatched; 400,000 fish being placed in the Potomac near Marshall's Point, and 400,000 sent to Central Station at Washington.

The sudden fall in the temperature of the water on the 7th of May is thought to have killed about 200,000 eggs. The remaining 2,000,000 eggs were shipped to the Central Station at Washington. On May 20 the fishery at White House Landing suspended fishing for the season, followed by Chapman's Point fishery on the 21st, and on May 27 the Fish Hawk returned to Washington, D. C.

Battery Station.—On the opening of navigation in March, 1884, William Hamlen, one of the experts in fish and oyster culture of the Commission, who had previously commanded the Lookout, was assigned to duty as superintendent of this station. During the early spring the force at the station was employed in clearing the seine-haul of obstructions and getting ready for the fishing season.

Preparations having been completed on the 14th of April, the fishing equipment was turned over to Messrs. Benjamin R. Sheriff & Co., with whom arrangements had been made for operating the seine during the season, this firm having bound itself to haul the seine under the general direction of the superintendent, and furnish all the ripe fish taken, for the uses of the Commission.

The season was very backward and the fishing was much interrupted by heavy winds and freshets. During the season the experiments of penning the immature shad in the pool were conducted, but not with very satisfactory results. It was, however, demonstrated that the male shad could be kept for a much longer period and with much better success than the females.

Towards the end of May, the fish having become very scarce, operations were suspended, with the result of the production of 1,839,000 of shad, which were turned loose in the waters immediately contiguous to the station, and 840,000 shipped to the tributaries of the Chesapeake Bay.

During this season coal-bins and an addition to the hatching-house were erected, together with a tower for the reception of two tanks for increasing the supply of water.

Congress having made an appropriation for the construction of additional piers and breakwaters, a pier or embankment running east and west from the station, about 495 feet, was built for the protection of the boats and to form, with a connecting pier from the westerly end of the dike already constructed, a pond for the culture of carp. This work was prosecuted under the United States Engineer Department.

Alongside the original wharf an additional space of 32 feet by 100 was filled in to give greater wharf facilities and on which to erect additional buildings. On this space has been located an iron oil-house, 10 feet square, in which all the paints, oils, and inflammatory materials are kept, as being the most remote point from the buildings.

As it has been found advisable to make this station the repair-shop and store-house for the launches, boats, &c., operating in the Chesapeake Bay region, the addition to the hatching-house was converted during the winter and summer months into a machine-shop. During the summer and winter the launches, boats, &c., were overhauled and placed in condition for future operations; and various minor improvements were made at the station to increase its facilities for accommodating the hatching apparatus, equipment of the steamers, &c., when not employed in hatching operations.

During the fall a portion of the work constructed by the Engineer Department was destroyed by a violent storm, and the engineer force having removed, as the appropriations were not adequate for the completion of the work, the damage was repaired by the Fish Commission force at the station.

Central Station.—The eggs obtained at the collecting stations on the Potomac River are forwarded to this station, where they are hatched and whence they are conveniently distributed by rail in all directions. The total number of fish and eggs received in good condition at the station for the season was 19,161,000, which were obtained as follows:

From Fort Washington Station, 17,926,000 eggs; from steamer Fish Hawk, 865,000 eggs and 370,000 fry.

The number of fry produced for the season was 13,200,000.

The following summary of production and distribution will be of interest in this connection:

Station.	Eggs obtained.	Fish hatched.
Battery (Havre de Grace, Md.)	4, 617, 500	2, 679, 000
Steamer Fish Hawk (Potomac River)	3, 000, 000	800, 000
Fort Washington (Potomac River)	19, 000, 000
Central Station (Washington, D. C.)	13, 200 000
Total	26, 617, 500	16, 679, 000

Distribution of young shad through Central Station in May and June, 1884.

Date.	Place of deposit.	Stream stocked.	No. of fish.
1884.			
May 2	Near Woodstock, Va	Shenandoah River	*250, 000
4	Frederick City, Md.	Monocacy River	*365, 000
6	Rappahannock Station, Va ..	Rappahannock River	*390, 000
6	Charlottesville, Va	Rivanna River	*250, 000
6	Rome, Ga.	Etowah River	*407, 000
7	Riverton, Va.	Shenandoah River	*300, 000
8	Taylorville, Va.	Little River	*300, 000
8	Near Greenville, Ala.	Patsaliga River	*200, 000
8	Evergreen, Ala.	Sopulga River	*180, 000
9	do.	Burnt Corn Creek	*200, 000
9	Milford, Va.	Mattaponi River	*300, 000
10	Browton, Ala.	Murder Creek	*180, 000
11	Charlottesville, Va.	Rivanna River	*300, 000
11	Toccoa, Ga.	Savannah River	*750, 000
11	Greenville Court House, S. C. .	Saluda River	*750, 000
12	Seaford, Del.	Nanticoke River	*1250, 000
15	Glens Falls, N. Y.	Hudson River	*1, 217, 000
17	Poplar Bluff, Ark.	Black River	*400, 000
17	Waynesborough, Va.	Shenandoah River	*250, 000
17	At the Little Falls, Md.	Potomac River	*370, 000
17	Newport, Ark.	White River	*400, 000
17	Little Rock, Ark.	Arkansas River	*300, 000
20	Luray, Va.	Hawk Bill Creek	*300, 000
21	Near Norwood, Va.	Tye River	*597, 000
21	Maiden's Adventure, Va.	James River	*597, 000
21	Mount Jackson, Va.	Shenandoah River	*230, 000
22	Chestertown, Md.	Chester River	*1250, 000
23	Woodstock, Va.	Shenandoah River	*250, 000
23	New Milford, Conn.	Housatonic River	*975, 000
28	Quitsman, Ga.	Withlacoochee River	*400, 000
28	Thomasville, Ga.	Ochlocknee River	*400, 000
June 5	East Bridge, Ariz.	Colorado River	*953, 000
9	Somerville, N. J.	Raritan River	*180, 000
	Total		13, 521, 000

* Product of Central Station.

† Product of Battery Station.

‡ Product of steamer Fish Hawk.

The distribution covered by the above table summarized by river basins was as follows:

To the Colorado River of the West, tributary to Gulf of California.....	953, 000
To the Mississippi River and minor tributaries of Gulf of Mexico	3, 247, 000
To rivers of the South Atlantic slope	1, 500, 000
To the Chesapeake and its tributaries	5, 549, 000
To the Hudson River, New York	1, 217, 000
To the Housatonic River, Connecticut	975, 000
To the Raritan River, New Jersey	80, 000
Total	13, 521, 000

The Cold Spring Harbor Station.—In May, 1884, 80,000 eggs were sent to this station from Washington, for the purpose of experimenting with hatching them in spring water. The eggs were placed in McDouald hatching-jars, with the water at an average temperature of about 60° Fahr.; and nine days after their receipt 78,000 fry were successfully planted in the Nissequague River, on Long Island. The loss of the eggs was very slight, being only 615, while only about twice as many of the fry died before planting. Owing to the coolness of the spring water, no fungus was found on the dead eggs. It should be stated, however, that a similar trial, which was made later, proved a failure. A fuller account of these experiments will be found in the Bulletin for 1884, page 198.

Results of planting shad in Georgia waters.—General Young, of Georgia, states that the plant of shad made in recent years in the Oostenaula

and Etowah Rivers has been a great success, and that a great many shad were taken out of these two rivers last spring and the year before.

Concerning the increase in shad in this State, due to propagation, Dr. H. H. Cary states in his report to the Commissioner of Agriculture for 1883 and 1884 that:

"In 1880, 1,000,000 shad fry were planted in the waters of Georgia, and in 1881, 1,800,000. This was the work of the United States Fish Commission. In three years after the planting they returned to find their spawning-grounds. Of the planting of 1880, 400,000 were released in the Chattahoochee, at Iceville, near Atlanta. It was not expected that these fish could pass up farther than Columbus till fishways were placed at the obstructions at that place. True to their instincts, shad appeared in 1883 in the Chattahoochee River below Columbus, and were taken with the hook and bait. It is therefore reasonable to suppose that the fish thus taken were of the planting at Iceville in 1880. Of the 1,800,000 shad planted in 1881, 1,000,000 were released in the Ocmulgee at Macon. The fish, of course, were due on their return in the spring of the present year. I have recently visited Macon and made careful investigation in regard to the expected return of these fish, and I am pleased to say that I have not been disappointed. While there was no particular arrangement for catching shad—and hence the catch was light—still they must have appeared in large numbers, as a sporting gentleman informed me that full-grown shad were taken in considerable numbers, the fishermen standing on the bank of the stream and capturing them with the dip-net. I mention these facts to show with what facility a barren river can be impressed by liberal plantings of the shad fry."

p. The River Herring (Pomolobus estivalis).

Large quantities of herring are often taken in the shad seines, and the opportunity has frequently been improved to impregnate the eggs and hatch them artificially.

q. The Carp (Cyprinus carpio).

The work connected with the carp may be considered among the most important of the operations of the Commission. The good results have been manifested over the entire country and the demand for the species is increasing year by year.

The number of carp raised in Washington, as reported by the superintendent of the ponds, Mr. Rud. Hessel, was as follows:

Place.	Scale carp.	Leather carp.	Blue carp.
North pond.....		24,440	
South pond.....		9,995	
East pond.....		80,450	
West pond.....		*50,000	
Arsenal pond.....	30,000		
No. 5 pond.....			14,370
No. 6 pond.....			2,400
Sand wharf pond.....			4,000
Total.....	30,000	164,900	20,770

* Estimated. In addition to this number, 57,000 were raised but were killed by frost in March, 1885.

Distribution of carp from October 28, 1884, to March 10, 1885.

State.	Point of distribution.	Number of counties included.	Number of applicants supplied.	No. of fish issued.		Total number of fish issued.
				To individual applicants.	To State commissioners.	
Alabama	Montgomery and Birmingham, Ala.	39	180	3,640	-----	3,640
Arizona	Ash Fork, Ariz.	6	65	1,270	700	1,970
Arkansas	Saint Louis, Mo., and Marshall, Tex.	19	140	2,801	-----	2,801
California	Ogden, Utah	16	19	380	-----	380
Colorado	Denver, Colo.	15	34	680	-----	680
Connecticut	Boston, Mass.	6	30	606	-----	606
Dakota	Saint Paul, Minn.	20	36	720	-----	720
Delaware	Washington, D. C.	3	13	210	100	310
Dist. of Columbia.	do	-----	13	260	-----	260
Florida	Jacksonville, Fla.	13	35	700	-----	700
Georgia	Atlanta and Albany, Ga.	111	820	17,109	*1,700	18,809
Illinois	Chicago, Ill.	84	425	7,194	12,000	19,194
Indiana	Indianapolis, Ind.	71	250	5,088	-----	5,088
Indian Territory	Dallas, Tex.	3	4	180	†1,800	1,980
Iowa	Des Moines, Iowa	58	155	2,976	3,000	5,976
Kansas	Topeka, Kans.	67	282	5,833	-----	5,833
Kentucky	Louisville, Ky.	21	41	827	350	1,177
Louisiana	Shreveport and New Orleans, La.	22	51	1,131	2,700	3,831
Maine	Boston, Mass.	2	2	40	-----	40
Maryland	Washington, D. C.	13	58	895	1,000	2,855
Massachusetts	Boston, Mass.	10	16	320	-----	320
Michigan	Northville, Mich.	1	63	1,282	-----	1,282
Minnesota	Saint Paul, Minn.	19	33	750	4,500	5,250
Mississippi	Jackson, Miss.	46	226	4,568	-----	4,568
Missouri	Saint Louis, Mo.	16	23	400	-----	400
Montana	Garrison, Mont.	6	10	410	-----	410
Nebraska	Omaha, Nebr.	28	63	1,324	940	2,264
Nevada	Ogden, Utah	1	3	60	-----	60
New Hampshire	Boston, Mass.	4	8	180	-----	180
New Jersey	New York, N. Y.	17	74	1,432	-----	1,432
New Mexico	Albuquerque, N. Mex.	10	33	880	-----	880
New York	New York, N. Y.	39	109	2,290	2,000	4,290
North Carolina	Charlotte, N. C.	63	771	15,110	-----	15,110
Ohio	Columbus, Ohio	73	398	8,005	2,900	10,905
Oregon	Portland, Oreg.	19	69	1,555	-----	1,555
Pennsylvania	Washington, D. C.	57	438	7,224	5,800	13,024
Rhode Island	Boston, Mass.	1	1	30	-----	30
South Carolina	Charlotte, N. C.	28	165	3,355	1,700	5,055
Tennessee	Nashville and Chattanooga, Tenn.	45	201	4,075	-----	4,075
Texas	Dallas, Austin, El Paso, and Marshall, Tex.	56	182	3,710	-----	3,710
Utah	Salt Lake City and Milford, Utah.	16	150	3,180	-----	3,180
Vermont	Boston, Mass.	5	9	100	400	500
Virginia	Washington, D. C.	72	453	7,074	-----	7,074
Washington	Portland, Oreg., and Walla Walla, Wash.	15	61	1,560	-----	1,560
West Virginia	Washington, D. C.	27	90	1,421	500	1,921
Wisconsin	Saint Paul, Minn.	20	31	624	-----	624
Wyoming	Laramie City, Wyo.	1	1	20	860	1,000
Mexico	-----	4	4	125	-----	125
Canada	-----	-----	5	100	-----	100
England	-----	-----	1	25	-----	25
Total	-----	1,315	6,313	123,018	44,030	167,048

* Planted in Tallapoosa River December 13, 1884.

† Planted in Arkansas and Red Rivers January 4, 1885.

The distribution to Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia was made October 28; to a part of Arkansas, to California, Colorado, Connecticut, Dakota, Georgia, Illinois, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Missouri, Montana, New Hampshire, New Jersey, New York, North Carolina, Ohio, Rhode Island, South Carolina, Tennessee, Vermont, Wis-

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consin, and Wyoming, in November; to Alabama, Florida, Kentucky, Nebraska, Nevada, Oregon, Utah, and Washington, in December; to Arizona, a part of Arkansas, to Indian Territory, a part of Louisiana, to New Mexico, and Texas, in January; to Mississippi, February 12, 1885, and to part of Louisiana, March 10, 1885.

Distribution to public waters of scale carp reared in 1884.

Date.	Stream.	Place.	Number.
Dec. 13, 1884	Tallapoosa River	Tallapoosa, Ga.	1,700
Jan. 4, 1885	Arkansas River	Muscogee, Ind. T.	900
Jan. 4, 1885	Red River	Denison City, Tex.	900
	Total		3,500

r. **The Goldfish** (*Carassius auratus*).

Goldfish were raised as usual at the carp ponds under the direction of Mr. Hessel, as follows: In pond No. 1, 3,900; in pond No. 2, 843; in 3 subdivisions of north pond, 7,900; total, 12,643. During this year fish were distributed to 524 applicants.

s. **The Golden Ide or Orf** (*Leuciscus idus*).

This ornamental fish, which occurs in great variety and is very attractive, is cultivated by the Commission for distribution, many persons preferring them to goldfish. There were 700 raised this year at the Washington carp ponds.

t. **The Tench** (*Tinca vulgaris*).

A small number of tench are cultivated in the Washington ponds, but there is little demand for them. There were 6,000 young produced this season.

u. **The Catfish** (*Amiurus nebulosus*).

In previous reports reference has been made to the successful introduction of the catfish (*Amiurus nebulosus*) into various waters, their multiplication, and the very high esteem in which the fish has been held as an article of food. In June, one hundred catfish from the Potomac River were sent to State Commissioner Gosper, of Prescott, Ariz., to be deposited in the Colorado River.

v. **The Clam** (*Mya arenaria*).

The Saint Jerome Station.—Interesting results as to the growth of the common clam or mananose (*Mya arenaria*) were obtained at St. Jerome after the completion of the ponds. As the ponds were excavated upon ground not before submerged, it was found that the young fry of the clam which had gained access to the ponds after the spawning season of the oysters was over had made a surprisingly rapid growth in the sandy bottoms of the ponds. In seven months it was found that the young clams would grow to a considerable size, their shells having made a growth of from 1 to 1½ inches in length in that period of time.

w. **The Oyster** (*Ostrea virginica*).

The Saint Jerome Station.—As it had been determined to continue the experiments in oyster culture at this station, which had been acquired from the Maryland Fish Commission in 1882, Mr. William deC. Ravenel was appointed superintendent, and ordered to the station, but owing to the ice blockade in the Potomac River, he did not reach his post until the middle of February, and early in March he was able to commence the work of the preparation of ponds.

During the spring five ponds were constructed and provided with flumes for controlling the inlet and discharge of water on the rise and fall of the tide. These ponds were from 50 to 60 feet square, and were located near the dwelling-house; they were formed by the excavation of the marsh land adjacent to the cut or canal which had been dredged by the engineer department. Their average depth was 3 feet at high water.

During the spawning season of the oyster, Prof. John A. Ryder was sent to the station to conduct personally the experiments. From the 25th of June, spawn was procured regularly from the oysters taken from the adjacent ponds and the bay, and after the young oysters were hatched they were placed in the ponds, which had been provided with collectors formed of tiles, slate, shingles covered with mortar, fagots, wheat straw, shells, &c. Floating apparatus was also used, consisting of troughs, or boxes with permeable ends of cloth, to admit of a change of the water by the action of the tidal currents. Artificially fertilized ova were placed in these boxes with very slight evidence of success.

Into the ponds great quantities of fertilized spawn were introduced from the early part of July until in September, when it became evident that the breeding season was about at an end. Some spat was obtained as a result of this method. But some of the ponds showed better results than others, the evidence being in favor of those through which there was the freest circulation of water. The results gave us a very complete confirmation of the results obtained in 1883, at Stockton, Md., and gave promise of further success the next season. That is, it was again shown that spat could be reared in artificially constructed inclosures.

At Wood's Holl two ponds were constructed in the fall of 1884, provided with very large filters at either end of the ponds. It was believed that the free access and circulation thus guaranteed would greatly favor our success. The subsequent trial of these ponds showed that the free circulation of the water thus established was a very desirable feature, as it seemed that the growth of the adult oysters in these ponds was greatly favored. Very rapid growth was made by the old oysters in these inclosures; in fact one-half inch of new shell was added to the margin of the valves of the old oysters in from six to eight weeks. It was also shown in the course of these experiments that oysters might be successfully grown at Wood's Holl, a locality in which that mollusk had never, so far as we know, been indigenous.

The improvements made by the engineer department at Saint Jerome during 1883 and 1884 caused the inclosure of a spacious pond, covering perhaps 10 or more acres, which may become a useful adjunct to future experiments. These improvements also render it possible greatly to extend the construction of other ponds or inclosed areas for purposes of oyster culture, though the excavation of the sandy flats for such purposes may be a trifle more expensive than upon the firm, loamy marshes found in many other places along the shores of the Chesapeake and Chincoteague Bays.

a. The American Lobster (Homarus americanus).

October 18, Lieut. W. M. Wood procured from Mr. E. G. Blackford, in New York, 125 live lobsters of small and medium size, many of them being females with a full supply of eggs. They were placed in a tank through which salt water was circulated, but quite a number died the first few hours. On arrival in the Chesapeake, the next day, he deposited 63 in good condition off Back River light.

D.—ABSTRACT OF THE ARTICLES IN THE APPENDIX.

25.—CLASSIFICATION OF ARTICLES.

In the general appendix to this report will be found a series of forty-two separate papers treating upon matters relating to the work of the Fish Commission. These are classified under five headings, as follows:

A.—REPORTS OF STEAMERS AND STATIONS

The first article is by Lieut.-Commander Z. L. Tanner, and gives a report of the work of the steamer Albatross during 1884, illustrated by three plates. In this report are also included subordinate reports by Lieut. Seaton Schroeder, Passed Assistant Engineer G. W. Baird, Surgeon James M. Flint, Naturalist James E. Benedict, and various tables of temperatures, specific gravities, stations occupied, records of dredging and trawling, and lists of fishes, invertebrates, &c., taken. Next is given a report by Lieut. W. M. Wood on the work of the Fish Hawk during 1883 and 1884; and a report follows by Mate James A. Smith on the work of the Lookout during 1884. The twelve papers which follow relate mostly to the propagating operations of the Fish Commission, and consist of reports from the persons charged with the work of propagation, distribution, or investigation. They consist of three reports on fish hatching, shipping eggs to foreign countries, and receiving them from foreign countries at the Cold Spring Harbor Station, by Mr. Mather; the operations at the Northville and the Alpena Station, by Mr. F. N. Clark; the salmon-breeding and trout-breeding work on the McCloud River, by Mr. Stone; the work in Maine in propagating Penobscot salmon and Schoodic salmon, by Mr. Atkins; the shad-hatching operations at the Fort Washington Station, by

Lieutenant Babcock ; the shad work at the Havre de Grace Station, by Mr. Hamlen ; the work with oysters at the Saint Jerome Station, by Mr. Ravenel ; and a report on the water supply of the station at Wood's Holl, by Dr. Kidder.

B.—THE FISHERIES.

The fifteen papers in this section are of a somewhat general or statistical nature, giving a view of the fisheries of this country and of northern Europe. The first article is a report by Colonel McDonald on the protection which should be afforded by law to the fisheries of the Atlantic coast. A paper follows on the New England fishery for swordfish during 1884, by Mr. A. Howard Clark. Next comes an article giving the statistics of the United States imports and exports of fish and fishery products, the tonnage of fishing vessels, &c., for the fiscal year ending June 30, 1884, compiled by Mr. Smiley from information furnished by the Bureau of Statistics. Captain Collins has an article on the use of gill-nets in the cod fisheries, with a description of the Norwegian cod-nets and a history of their use in the United States, illustrated by twelve plates ; and another paper giving an account of the trips of three Gloucester schooners to the Iceland halibut fishing-grounds. The fisheries of Iceland are treated of in four papers, each being a translation from the Danish. The statistics of the Norwegian fisheries in 1880 are given by Boye Strom, after which comes a translation from the Danish on the need of a central management for the Norwegian fisheries. A valuable paper is given by Dr. Rudolph Lundberg on the fisheries of Sweden, illustrated by a plate showing some of the kinds of apparatus used. This is followed by an article from the Swedish by Prof. A. V. Ljungman on the future of the herring fisheries on the coast of Bohus ; and an other from the Danish by Lieut. Carl Trolle on salting fish in Jutland. The last paper of the section is a translation from the Danish on the salting of herring, giving valuable information and suggestions in regard to this work.

C.—FISH-CULTURE.

The first of the five papers in this section is a review of the failures and successes of artificial fish-culture, by Von der Wengen. This is followed by a long article, by Carl Nicklas, on pond culture, being specially applied to the methods of carp culture in Germany, illustrated by forty-four figures and provided with a table of contents and special index. Next is an article by Chas. W. Smiley on some results of carp culture in the United States, which consists mostly of statements of persons thus engaged. An article by Dr. Horst, translated from the Danish, on the development of the European oyster, is illustrated by two plates ; and is followed by a statement, translated from the Danish, on oyster culture as seen at the London Fisheries Exhibition, by S. A. Buch.

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D.—SCIENTIFIC INVESTIGATION.

Of the five papers in this section, the first is a report by J. Walter Fewkes, on the medusæ collected by the Albatross in the Gulf Stream region in 1883-'84, illustrated by ten plates. The next is an article on the origin of heterocercy and the evolution of the fins and fin-rays of fishes, illustrated by eleven plates and eight figures, by John A. Ryder. Messrs. Chittenden and Cummins furnish a paper on the relative digestibility of fish flesh in gastric juice, with tables of their experiments. Two translations from the German follow, the first on the migrations of eels, by Dr. Hermes; and the other being a contribution to the natural history of parasites as affecting certain kinds of fish, by Dr. Kerbert.

E.—MISCELLANEOUS.

In this section is a statement of the status of the U. S. Fish Commission in 1884, by G. Brown Goode; while the appendix is concluded by a paper from the German on the results of the London Fisheries Exhibition in their practical value for Germany, by Dr. Benecke, being a general review of the subject and of the articles exhibited.

This series of forty-two papers contains many of high value, and is illustrated by nearly one hundred plates and figures. Nine of the longest articles are provided with special indexes, as it is often desirable to issue these papers in separate pamphlet form for distribution to specialists not interested in the contents of the entire volume.

E.—SUPPLEMENT TO THE REPORT PROPER.

26.—LIST OF LIGHT-HOUSE KEEPERS RENDERING ASSISTANCE.

The following is a list of the light-houses (with their keepers) at which temperatures and occurrences of ocean fish have been observed during a portion or all of the present year:

List of light-houses on the Atlantic coast at which ocean temperatures have been taken during the year 1884, together with the number of monthly reports made at each one.

Petit Manan light-house, Petit Manan Island.	
George L. Upton, Millbridge, Me	12
Mount Desert light-house, Mount Desert Rock.	
Thomas Milan, Southwest Harbor, Me	12
Matinicus Rock light-house, Penobscot Bay.	
William G. Grant, Matinicus, Me	12
Seguin light-house, Seguin Island, Kennebec River.	
Thomas Day, Hunnewell's Point, Me	12
Boon Island light-house, Boon Island, Me.	
Alfred J. Leavitt, box 803, Portsmouth, N. H.	12
Minot's Ledge light-house, Cohasset Rocks, Boston Bay.	
Frank F. Martin, Cohasset, Mass	12
Race Point light-house, Cape Cod Bay.	
James Cashman, Provincetown, Mass	12

Pollock Rip light-station, entrance to Vineyard Sound.	
Joseph Allen, jr., South Yarmouth, Mass	12
Nantucket New South Shoal light-station, Davis New South Shoal.	
Andrew J. Sandsbury, Nantucket, Mass. (Isaac Hamblen, Nantucket, Mass., reported August and September)	12
Cross Rip light-station, Vineyard Sound.	
Luther Eldridge, Chatham, Mass	12
Buoy Depot, Government wharf, office of Light-House Inspector.	
Benjamin J. Edwards, Wood's Holl, Mass	12
Vineyard Sound light-station, Sow and Pigs Rocks.	
William H. Doane, 13 Kempton street, New Bedford, Mass. (A. H. Bray reported for month of January)	12
Brenton's Reef light-station, off Brenton's Reef and Newport Harbor.	
Charles D. Marsh, 54 John street, Newport, R. I.	12
Block Island light-house, southeast end of Block Island.	
H. W. Clark, Block Island, R. I.	12
Bartlett's Reef light-station, Long Island Sound.	
Daniel G. Tinker, New London, Conn.	12
Stratford Shoals light-house, Middle Ground, Long Island Sound.	
James G. Scott, Miller's Place, Suffolk County, New York	12
Fire Island light-house, south side of Long Island.	
Seth R. Hubbard, Bay Shore, N. Y.	12
Sandy Hook light-house, entrance to New York Bay.	
R. H. Pritchard, 120 Spencer street, Brooklyn, E. D., N. Y.	12
Absecom light-house, Absecom Inlet.	
A. G. Wolf, Atlantic City, N. J.	12
Five-Fathom Bank light-station, off Delaware Bay.	
William W. Smith, Cape May, N. J.	12
Fourteen-Foot Bank light-station, Delaware Bay.	
Ed. A. Howell, Delaware City, Del.; and John Lund, Wilmington, Del.	12
Winter-Quarter Shoal light-station, Chincoteague Island.	
C. Lindemann, 857 Broadway, Brooklyn, E. D., N. Y.	12
York Spit light-house, Chesapeake Bay.	
James K. Hudgins, Port Haywood, Va.	12
Wolf-Trap Bar light-house, Chesapeake Bay, Va.	
John L. Burroughs, New Point, Matthews County, Va.	12
Stingray Point light-house, Chesapeake Bay.	
Charles F. Sadler, Hudgins, Va.	12
Windmill Point light-house, mouth of Rappahannock River.	
James G. Williams, Hudgins, Va.	12
Point Lookout light-house, mouth of Potomac River.	
William Yeatman, Cornfield, St. Mary's County, Md. (Record began December 1, 1884)	1
Body's Island light-house, north of Cape Hatteras.	
Peter G. Gallop, Manteo, Dare County, N. C.	12
Cape Lookout light-house, Cape Lookout.	
Denard Rumley, Beaufort, N. C.	12
Frying-Pan Shoal light-station, Cape Fear.	
John D. Davis, Smithville, N. C.; George D. Walker, Smithville, N. C.; and Henry Swan, Smithville, N. C.	12
Rattlesnake Shoal light-station, off Charleston.	
John McCormick, Charleston, S. C.	12
Martin's Industry light-station, off Port Royal.	
John Masson, Beaufort, S. C.	12

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Fowey Rocks light-house, Fowey Rocks.	
John J. Larner, Miami, Fla	12
Carysfort Reef light-house, Florida Reefs.	
F. A. Brost, Key West, Fla	12
Dry Tortugas light-house, Loggerhead Key.	
Robert H. Thompson, Key West, Fla	12

27.—LIST OF RAILROADS FURNISHING TRANSPORTATION AT REDUCED RATES.

It has already been mentioned that the railroads of the country in general have transported the cars of the Commission at a rate of 20 cents per mile, this including the fare of five messengers—a figure very much less than the usual charge for such service, and showing the favorable consideration entertained by the companies toward the work of the Commission. In some cases 10 cents per mile has been charged; in other cases 5; and again, for many thousands of miles the service has been conducted without any cost whatever to the Commission. The only road that charged any more than 20 cents is the Union Pacific, on the trip to Ogden, Utah, and return, during the latter part of November.

List of railroads that moved cars, and messengers to the number of five accompanying, at the rate of 20 cents a mile during the year 1884.

	Miles.
Alabama Great Southern Railway; Chattanooga, Tenn.....	143
Baltimore and Ohio Railroad; Baltimore, Md	546
Central Railroad of Georgia; Savannah, Ga	239
Charlotte, Columbia and Augusta Railroad; Columbia, S. C	191
Chicago, Burlington and Quincy Railroad; Chicago, Ill	503
Chicago, Milwaukee and Saint Paul Railway; Milwaukee, Wis.....	580
Chicago and Northwestern Railway; Chicago, Ill.....	467
Cumberland Valley Railroad; Chambersburg, Pa	74
Delaware and Hudson Canal Company; New York, N. Y	123
Delaware, Lackawanna and Western Railroad; New York, N. Y	497
East Tennessee, Virginia and Georgia Railroad; Knoxville, Tenn	1,758
Georgia Pacific Railway; Birmingham, Ala	167
Housatonic Railroad; Bridgeport, Conn	70
Louisville and Nashville Railroad; Louisville, Ky.....	338
New York, New Haven and Hartford Railroad; New York, N. Y.....	102
New York, West Shore and Buffalo Railroad; New York, N. Y.....	282
Norfolk and Western Railroad; Philadelphia, Pa	967
Pennsylvania Railroad; Philadelphia, Pa.....	7,201
Pennsylvania Company; Pittsburg, Pa	2,039
Pittsburg, Cincinnati and Saint Louis Railway; Pittsburg, Pa	3,048
Richmond and Danville Railway; Richmond, Va	957
Richmond, Fredericksburg and Potomac Railroad; Richmond, Va	82
Savannah, Florida and Western Railroad; Savannah, Ga	258
Shenandoah Valley Railroad; Philadelphia, Pa	239
Terre Haute and Indianapolis Railroad; Terre Haute, Ind.....	1,680
Virginia Midland Railway; Alexandria, Va	1,702
Western and Atlantic Railroad; Atlanta, Ga.....	140
Total.....	24,393

Concessions of free transportation for cars and messengers, and every facility for the convenience and expedition of the work of distribution, have been afforded by 26 roads. The aggregate number of miles of free transportation received was 21, 865.

List of railroads that moved cars, and messengers to the number of five accompanying, free of charge during the year 1884.

Atchison, Topeka and Santa Fé Railroad Company; Topeka, Kans.
 Atlantic and Pacific Railroad; Albuquerque, N. Mex.
 Chicago and Grand Trunk Railway; Chicago, Ill.
 Chicago, Milwaukee and Saint Paul Railway; Milwaukee, Wis.
 Chicago and Northwestern Railway; Chicago, Ill.
 Detroit, Grand Haven and Milwaukee Railway; Detroit, Mich.
 Detroit, Lansing and Northern Railroad; Detroit, Mich.
 Flint and Pere Marquette Railroad; East Saginaw, Mich.
 Grand Rapids and Indiana Railroad; Grand Rapids, Mich.
 Grand Trunk Railway; Montreal, Canada.
 Great Western Railway of Canada; Toronto, Canada.
 International and Great Northern Railroad.
 Lake Shore and Michigan Southern Railway; Cleveland, Ohio.
 Michigan Central Railroad; Detroit, Mich.
 Milwaukee, Lake Shore and Western Railway; Milwaukee, Wis.
 Missouri Pacific Railway; Saint Louis, Mo.
 Northern Pacific Railroad; Saint Paul, Minn.
 Oregon Railway and Navigation Company; Portland, Oreg.
 Richmond and Alleghany Railroad; Richmond, Va.
 Rome, Watertown and Ogdensburg Railroad; Oswego, N. Y.
 Saint Louis, Iron Mountain and Southern Railway; Saint Louis, Mo.
 Spartanburg and Ashville Railroad; Spartanburg, S. C.
 Texas and Pacific Railway; Dallas, Tex.
 Utah Central Railway; Salt Lake City, Utah.
 Wabash, Saint Louis and Pacific Railway; Saint Louis, Mo.
 Wisconsin Central Railroad; Milwaukee, Wis.

The Union Pacific Railway moved a car from Kansas City, Mo., to Ogden, Utah, and from Ogden to Council Bluffs, Iowa, at a somewhat reduced rate, 2,328 miles.