

# REPORT OF THE COMMISSIONER.

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## A.—GENERAL CONSIDERATIONS.

### 1.—INTRODUCTORY REMARKS.

The duties assigned to the United States Commissioner of Fish and Fisheries, as indicated in the law authorizing his appointment, consist, first, in the investigation of the causes of decrease in the supply of useful food-fishes of the United States, and of the various factors entering into the problem; and, second, the determination and employment of such active measures as may seem best calculated to stock or restock the waters of the rivers, lakes, and the sea.

Twelve annual reports, containing in all upwards of 12,800 octavo pages, as well as several hundred plates, have heretofore been issued. This, the thirteenth, swells the total number of pages to upwards of 14,000. It covers the operations of the Commission during the calendar year 1885 and in part for 1886, being the fifteenth year of its history.

Year by year a more or less rapid and continual expansion of the Commission has been chronicled, increased appropriations have been made, indicative of the appreciation by Congress of the efforts put forth, and a growing demand from the people of the country for assistance in maintaining and increasing the food supply of the nation has been developed. As heretofore, the work of the Commission has been aided and supplemented by that of the various State commissioners acting under appointment from the governors of the different States and Territories. Relations with all these have been cordial and harmonious, and each, in varying methods, has done what was possible with the means placed at his disposal. The State commissioners are in no sense responsible to the United States Commissioner, and whatever co-operation has taken place has been of a purely voluntary nature. The following States and

Territories have been represented during the present year by the number of commissioners indicated :

State.	No.	State.	No.	State.	No.
Alabama .....	2	Maine .....	3	Pennsylvania .....	6
Arizona .....	3	Maryland .....	2	Rhode Island .....	3
Arkansas .....	2	Massachusetts .....	3	South Carolina .....	1
California .....	3	Michigan .....	3	Tennessee .....	3
Colorado .....	1	Minnesota .....	3	Vermont .....	2
Connecticut .....	3	Missouri .....	3	Virginia .....	1
Delaware .....	1	Nebraska .....	3	Washington .....	1
Georgia .....	3	Nevada .....	1	West Virginia .....	3
Illinois .....	1	New Hampshire .....	3	Wisconsin .....	7
Indiana .....	1	New Jersey .....	3	Wyoming .....	3
Iowa .....	1	New York .....	4		
Kansas .....	1	North Carolina .....	1		
Kentucky .....	10	Ohio .....	3	Total .....	97

There has also been hearty co-operation with the work of investigation by various men of science, notably by those connected with Government bureaus of this and other countries, and with many of the leading colleges and educational organizations of the country. To the latter it has been possible for the Commission to supply, in return, collections of marine forms and other material of great value for class-room instruction, and for museum purposes. These collections involve no expense to the recipients beyond the cost of freight, of alcohol, and of suitable receptacles for exhibition and storage, and are assigned to schools and colleges upon recommendation of the member of Congress from the district in which the institutions are located.

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

1. The completion of the suite of buildings at Wood's Holl, and their occupancy, for the purposes of investigation and fish production.

2. The exploration of the fishing-grounds of the Gulf of Mexico by the steamer Albatross, and the investigation of the red snapper and other fisheries.

3. The appropriation of \$14,000 for building the schooner Grampus, the construction of plans, and the award of the contract for building to Messrs. Robert Palmer & Sons, of Noank, Conn.

4. Participation in the New Orleans Cotton Centennial Exposition, at which were exhibited the steamer Albatross, with her appliances for research and practical work, and a hatching car fully equipped with eggs and live fish.

5. The taking of a census of the fisheries of the Great Lakes for purposes of comparison with that of five years ago.

6. The co-operation of the Treasury Department in obtaining statistics of the sea fisheries of the Atlantic Ocean.

7. The examination of the oyster-beds of Long Island Sound by the steamer Lookout under the direction of Mr. E. G. Blackford.
8. The importation of several installments of live soles from England, and of the eggs of Loch Leven trout and *Coregonus albula*.
9. The hatching of cod at Wood's Holl, of grayling at Northville, and of shad at a new station on the Delaware.
10. The building of a shad hatchery at Fort Washington on the Potomac River.
11. The discovery of a rational system of oyster culture, including the collection of spat by a new process proposed by John A. Ryder.
12. The transportation of clams from Tacoma, Wash., on the Pacific coast, to Wood's Holl Station upon a car of the Commission.
13. The successful confinement of young shad in a pond from June to November.
14. The extensive distribution of carp to private ponds and numerous plants made in public rivers.
15. The continued efforts and increased results in taking and hatching the eggs of shad, whitefish, trout, salmon, and other species of food-fish at previously established stations of the Commission.
16. The exportation of live catfish to Holland, France, Germany, and England; and of large shipments of whitefish eggs to Germany, Switzerland, and Australia.
17. The introduction to commerce of smoked kingfish.
18. The record of the establishment of the Iceland halibut fishery as a profitable undertaking for American fishermen.
19. The meeting in Washington of the American Fisheries Society.
20. The publication of Section I of the quarto fishery report in two large volumes, one of text and one of plates.

The work connected with the administration of the office has probably been greater during the present year than in any preceding year. The number of letters received, registered, and indexed during the fiscal year ending June 30, was 14,174, and the number written during the same period, 10,549, or a total of 24,723. In addition, there were received 3,994 applications for fish and several thousand statistical returns relating to the lake fisheries, the sea fisheries, and the culture of carp.

This increase in the office work of the Commission has necessitated additional room, and on the 1st of October the house immediately north of the Fish Commission office, known as 1448 N street, N. W., was leased and has since been occupied as offices of the disbursing agent and his clerks.

It gives me much pleasure to record that during the year no casualties have occurred to the immediate *personnel* of the Commission, and no serious interruption of work in consequence of death or prolonged sickness of any of its members. The death of Prof. Henry J. Rice, which occurred at his home in Brooklyn, N. Y., on December 14, however, in-

volved a serious loss on account of the interruption of the valuable embryological work, which he conducted for the most part at the private laboratory of Mr. E. G. Blackford, Fulton Market, New York City, and in which the Commission was much interested. The general cause of fish-culture has also suffered in the death of Mr. George Henry Jerome, which occurred August 15, at Niles, Mich. He was for a time a member of the State Board of Fish Commissioners of Michigan, and was the first State superintendent of Michigan fisheries. Many years of his life were devoted to the cause of fish-culture, and his influence was often potent with the legislature of his adopted State when questions arose with reference to the fisheries.

## 2.—STATIONS OF THE UNITED STATES FISH COMMISSION.

During the present year all of the stations which were occupied during 1884 have been in use, and there have been added thereto temporary stations on the Delaware River for the purpose of hatching shad.

### A.—INVESTIGATION AND RESEARCH.

(1) *Gloucester, Mass.*—This station was first occupied in 1878, and has been maintained ever since on account of the opportunities furnished for securing information with reference to the sea fisheries. In February of the present year the office was placed in charge of Mr. W. A. Wilcox, secretary of the American Fish Bureau. With the assistance of Capt. S. J. Martin, statistics of the fisheries have been collected, from which monthly reports have been compiled and published in the Fish Commission Bulletin. Mr. Wilcox has also assisted in obtaining extended information relative to the sea fisheries.

(2) *Wood's Holl, Mass.*—This station, which has been occupied since 1881, is the largest and perhaps the most important of all occupied by the Commission. It furnishes a harbor and wharfage for the steamers of the Commission which are engaged in research along the North Atlantic coast each summer. It is fitted up especially for the propagation of marine forms, such as the cod, the lobster, and the oyster. It is in charge of Capt. H. C. Chester, and is occupied by the Commissioner in person during three or four of the summer months.

(3) *Saint Jerome, Md.*—This station, established in 1881, is used for experimental work in connection with oyster culture, and is in charge of W. de C. Ravenel. Five ponds have now been constructed, and during the year extended observations have been made upon the densities of sea-water in various typical localities.

### B.—PROPAGATION OF SALMONIDÆ.

(4) *Grand Lake Stream, Me.*—This station since 1875 has been operated jointly in the interest of Maine, New Hampshire, and Massachusetts, and of the United States, and is under the direction of Mr.

Charles G. Atkins. Work is confined to propagating landlocked or Schoodic salmon, of which 641,000 eggs were taken the present year.

(5) *Bucksport, Me.*—This is one of the oldest stations of the Commission, having been established in 1872, and is also under the direction of Mr. Atkins. It is devoted to the production of eggs of the Penobscot salmon, of which 2,315,000 were secured during the present year. An installment of eggs of *Coregonus albula* from Germany was hatched and deposited in Heart Pond, Orland, Me., and Lake Hebron, Monson, Me.

(6) *Northville, Mich.*—This station, established in 1872, was one of the first occupied by the Commission and has been in continuous operation. It was first established for the propagation of whitefish, but at present its operations extend to the cultivation of brook trout, rainbow trout, lake trout, landlocked salmon, and brown trout. It has been in charge of Mr. F. W. Clark for a number of years and has produced several hundred millions of eggs of the whitefish.

(7) *Alpena, Mich.*—This station was organized in 1882 as an auxiliary to the Northville Station. Whitefish eggs are taken at Alpena and forwarded to Northville for development. This is also under direction of Mr. Clark.

(8) *Baird, Cal.*—This station was opened in 1873 for the purpose of securing eggs of the California salmon. It was operated for this purpose for about ten years, but during the year 1884 and the present year no eggs have been taken, although a keeper has been in charge. Mr. Livingston Stone has superintended it from its inception.

(9) *Trout ponds near Baird, Cal.*—This, as well as the preceding station, is situated on the McCloud River, and is also under direction of Mr. Stone, although more immediately carried on by Mr. L. W. Green. It has been operated since its establishment in 1879 for securing eggs of California or rainbow trout, of which 246,000 were obtained in 1885. During the present year a disease developed among the trout which caused some alarm, and which was investigated by Prof. S. A. Forbes, with the result of ascertaining that it was identical with that which swept off such large quantities of fish in the Wisconsin lakes in 1884.

(10) *Wytheville, Va.*—This station, the property of the State of Virginia, has been used by the United States Commission since 1883, through the courtesy of Colonel McDonald, the State commissioner. Its superintendent is Mr. George A. Seagle. It is used for the propagation of Penobscot salmon, California trout, brook trout, Rangeley trout, lake trout, black bass, red-eye perch, carp, and grayling. During the present summer a new hatchery was erected with a capacity of 500,000 eggs. Several small ponds were also constructed and the distribution of the water supply completed.

(11) *Cold Spring Harbor, N. Y.*—This station is the property of the New York State Fish Commission, and is in charge of Mr. Fred Mather, since 1883. Through the courtesy of Mr. E. G. Blackford, one of the State commissioners, work has been performed in behalf of the United

States Commission in connection with the propagation of whitefish, brook trout, rainbow trout, brown trout, Penobscot salmon, and land-locked salmon.

#### C.—PROPAGATION OF SHAD.

(12) *Battery Station, Md.*—This station has been operated since 1876 for the purpose of hatching shad, the young of which have either been returned to the waters of Chesapeake Bay or transported to other portions of the country for introduction to new waters. During a portion of the season the steamer Lookout, Mate James A. Smith, was in attendance to co-operate with the work. In the present season over 10,000,000 young fish were hatched, of which about one-half were deposited in the immediate vicinity.

(13) *Central Station, Washington, D. C.*—In 1881 the old Armory building was assigned to the Commission for the purpose for which it is now used. It receives at different times of the year eggs of shad, herring, salmon, whitefish, and various kinds of trout, to be hatched and distributed by cars to various portions of the country. The station is in charge of Colonel McDonald.

(14) *Fort Washington, Md.*—Stations in this vicinity have been occupied by the Commission since the year 1874 for the purpose of collecting shad eggs. The immediate locality was first occupied in 1883 by permission of the War Department. During the present year a building was constructed near the wharf, to be used as a hatchery and for the storage of eggs, of which over 22,000,000 were taken. It is in charge of Col. M. McDonald, and practically is an outpost of the Central Station.

(15) *Gloucester City, N. J.*—This station, situated on the Delaware River, was first occupied the present year. The steamer Fish Hawk was stationed at this point from May 23 to June 10, and succeeded in securing over 10,000,000 eggs. This work was under charge of Lieut. L. W. Piepmeyer, U. S. N., commanding the vessel.

The steamer Lookout, Mate James A. Smith commanding, made two trips to the Delaware for the purpose of collecting shad eggs, most of which were transferred to Battery Station.

(16) *Lambertville, N. J.*—A temporary station was organized at this place during the present year, for the first time, for the purpose of hatching shad eggs. Car No. 3, in charge of Mr. J. F. Ellis, fully equipped with shad-hatching apparatus, was moved to this point early in June, where it remained until the middle of July and met with fair success.

#### D.—PROPAGATION OF CARP.

(17) *Monument Reservation, Washington, D. C.*—The carp ponds were established at this point in 1878, since which time large numbers of scale, mirror, and leather carp have been produced. There have also been grown in limited numbers goldfish, golden ides, and tench. During the present year the experiment was made of confining shad in one

of the ponds throughout the summer, which proved successful. Mr. Rudolph Hessel is in charge.

(18) *Arsenal Grounds, Washington, D. C.*—This station is supplementary to the Monument Reservation Station, and has been used since 1878 for the cultivation of scale carp. It is in charge of Mr. Richard Lynch.

For information with reference to the actual work accomplished with different species of fish and eggs at these various stations, the reader is referred to a later portion of this report, where there will be found a full list of species cultivated by the Commission and a statement of the success attained with each variety.

### 3.—NEW HATCHING STATION PROPOSED.

In Colorado and elsewhere in the Rocky Mountain region there occurs in considerable numbers the Rocky Mountain trout\* (*Salmo purpuratus*), which is deemed by ichthyologists much more worthy of propagation in Eastern lakes and streams than *Salmo irideus*, as attaining a larger size, being more active, and inhabiting a wider variety of waters. Mr. Pierce, the Colorado Fish Commissioner, describes it as occurring at the Twin Lakes, in Lake County of that State, of good size, and in abundance sufficient to warrant artificial propagation. (The Twin Lakes are 5 miles from Twin Lake Station, on the Denver and Rio Grande Railroad, and 18 miles from Leadville.) He says: "It is rarely caught at less than 2 pounds weight, and runs from that to 10 pounds. The specimens I saw were 4, 5, 7, and 10 pounds, respectively." During June of the present year he sent an agent to Twin Lakes, who put up a hatchery at the foot of the lower lake with a capacity of 1,000,000 eggs. He had no difficulty in procuring plenty of fish with a seine or in trapping them between the lakes in large quantities. Only a few eggs were secured during June, which led to the conclusion that the work should have commenced earlier, perhaps in April. What eggs were obtained were hatched, and about 1,000 of fry were removed to a pond at the State hatchery at Denver. At the upper end of the smaller of

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\* Prof. D. S. Jordan says: I feel very sure that this trout is the most valuable one we have, and I would like to see it have a chance.

My preference for *Salmo purpuratus* over *Salmo irideus* lies in this: It reaches a larger size, and from the extent of its distribution (every river and lake from Southeast New Mexico, Colorado, Dakota to Oregon and Kamchatka) it seems more adaptable to a variety of circumstances and waters. It is a handsomer, more active species. It is unquestionably different from *S. irideus*, having a larger mouth, teeth on the hyoid bone, and especially much smaller scales.

From two red blotches under the chin, always present in life, I have suggested that it be called the red-throated trout. It thrives in lakes. Utah Lake is full of them, and they run up the Provo River in such numbers that the irrigating ditches scatter them all over the meadows. The finest specimens I have seen are those from Lake Tahoe, where they reach 26 pounds weight. There is a little hatchery now at Tahoe City, Nevada. This locality is the best I know. Next I would place Provo, Utah.

the lakes there is an abundance of spring water suitable for hatching. The State of Colorado having made no appropriation for 1885-'86, the use of the State hatchery was tendered to the United States Commission by Mr. Pierce, with the approval of Governor Eaton. Senator Teller also manifested his interest and approval of the proposed work. In addition to the State hatchery Mr. Pierce owns a private hatchery of 300,000 eggs capacity, at which he raises trout for market.

Mr. Pierce was informed that the establishment of a trout-breeding station in Colorado would be considered a very important auxiliary to the work of this Commission, and that as early as practicable a reconnaissance of the lakes, their location and surroundings, would be made with a view to active operations. The actual equipment of the station when once erected would be inexpensive, as the necessary apparatus is now on hand. The matter remains in abeyance for future consideration.

#### 4.—VESSELS OF THE U. S. FISH COMMISSION.

##### A.—THE STEAMER ALBATROSS.

The Albatross, under the command of Lieut.-Commander Z. L. Tanner, U. S. N., continued during the year to do valuable work in connection with the investigations and researches required of the Commission by the Government.

At the beginning of the year all preparations for sea had been completed, and on January 3 the vessel left the navy-yard at Washington and proceeded to sea under instructions to make a full and careful investigation of the food-fishes and fisheries of the Gulf of Mexico, including a trip to the island of Cozumel off the coast of Yucatan, and a visit to the New Orleans Exposition as a part of the display of the Fish Commission. While in the Gulf Stream off and to the southward of Cape Hatteras the weather was too rough to admit of much deep-sea research or a satisfactory attempt to search for tile-fish, and the vessel was finally run out of the stream and headed for Key West, where she arrived on the 9th. After lying there a few days the Albatross steamed over to Havana, where the usual courtesies were extended by the officials of the port, and in the vicinity of which some valuable scientific work was done.

Leaving Havana the vessel proceeded across the Gulf to the island of Cozumel, making soundings and dredgings on the way, reaching the island on the 22d of January, where she remained until the 29th, during which time an investigation was made of parts of the island, especially of the village of San Miguel, and numbers of birds and marine specimens were obtained. Soundings were next made on the Campeche Banks, but the examination of this region was cut short by sickness on board, and the vessel proceeded to Pensacola, where a typhoid patient was transferred to the hospital. Some investigations were made on the fishing-banks off Cape San Blas in regard to the character of the bot-



tom and the marine fauna, after which the vessel proceeded to New Orleans, reaching there on February 13. Here from February 20 to March 1 the Albatross was on exhibition at the exposition wharf, during which time many thousands of people from all parts of the country visited her and expressed great interest in what they saw.

On the 1st of March the steamer left New Orleans for Pensacola, making soundings and dredgings on the way. From the 6th to the 19th the time was occupied in an examination of the fishing-grounds and fisheries off the west coast of Florida, especial attention being given to the red-snapper banks off Cape San Blas, which were visited under the guidance of Mr. Silas Stearns, of Pensacola. Capt. Joseph W. Collins was also on board, and a full account of the investigation will be found in his report in the appendix. On March 20 the vessel arrived at Key West, where coal was taken on and some necessary repairs were made.

On the 30th the return passage to Washington was begun, and unsuccessful attempts were made to take tile-fish. From the middle of the Gulf Stream to the coast and for some distance up Chesapeake Bay a line of soundings and a set of serial temperatures were taken, which are likely to prove of great value in connection with the study of the movements of migratory fish at this season. On the 6th of April the vessel was again at the Washington navy-yard, having made the entire cruise without any notable accident or loss.

The next trip was made from June 2 to the 7th, being chiefly in search for tile-fish off the mouth of the Chesapeake Bay and along the coast towards Cape Hatteras. None were taken, but much trawling and dredging was done, and the naturalists obtained a considerable variety of deep-water and surface forms of life.

The summer cruise of the Albatross was begun June 13, when she left the Washington navy-yard under instructions to visit and make an examination of the Newfoundland Banks. Arriving at Newport, further preparations were made for the cruise, and on the 17th she again proceeded to sea. Two reported shoals were sounded on, in accordance with a request from the Bureau of Navigation, and their non-existence was verified. Numerous soundings and investigations of the bottom at various portions of the banks were made, with a view of furnishing data for a contour map of the fishing-banks, while the usual examinations were made to determine the biological conditions of the grounds. Some torpedoes were exploded for the purpose of ascertaining the results on the marine life of the vicinity. The vessel returned to Wood's Holl on July 16, where she remained until August 6, making necessary repairs and preparing for a fresh trip to the former tile-fish grounds.

During August and September two trips were made from Wood's Holl, having for their principal object the investigation of grounds where tile-fish were formerly found, and the taking of specimens of that fish if possible. Much valuable scientific work was done in dredging, sounding, taking temperatures, and in investigating some of the

more obscure forms of marine life. No traces of tile-fish, however, were found. The result of the search of the Albatross for this fish during the year, taken in connection with the similar results of other investigations made since 1882, by this vessel and others, seems to indicate that the tile-fish have been entirely exterminated, or at least have abandoned our coast. The search has been made for them with much care, as they promised to be a fish of great commercial value, and had been taken in considerable numbers during the seasons of 1880 and 1881, previous to the unprecedented destruction of the species in March and April of 1882.

On October 8 the Albatross left Wood's Holl, and stopped at Newport and New York, before going on a short trip of investigation off the capes of the Delaware and the Chesapeake and a little farther south. On the 24th she returned to the navy-yard at Washington, where she remained until the end of the year, engaged in refitting and preparing for future work.

In the appended report of Captain Tanner on the work of the Albatross in 1885 will be found full details as to the officers and specialists on board, as well as of the several trips made; while added to his report in general on the operations of the vessel will be found reports of the navigator, engineer, surgeon, naturalist, and several valuable tables containing statistical and other details.

#### B.—THE STEAMER FISH HAWK.

As stated in the report of 1884, Lieutenant Wood was relieved from the command of this steamer December 31. Lieut. L. W. Piepmeyer succeeded him at that date and remained in command throughout the year. From the 1st of January to the 25th of April the vessel was engaged in various duties in connection with the Havre de Grace Station, and work in Chesapeake Bay. On the 7th of May the American Fisheries Society, which was holding its annual meeting in Washington, was invited to a trip upon the Fish Hawk to witness the shad work at Fort Washington. The excursion occupied the entire afternoon, furnishing the members ample opportunity for witnessing the hauling of the seine and the manipulation of the eggs in the hatching house. From the 16th to the 20th of May the vessel was moored at Fort Washington and the crew were instructed in spawn-taking. She then proceeded to the Delaware, arriving at Gloucester Point May 23, and remained in those waters until June 10, visiting the fisheries and collecting shad eggs. Of a total of 10,000,000 eggs, over 8,000,000 were hatched and the fry returned to the Delaware River. On the 11th of June the steamer was placed on exhibition at Burlington to enable those interested in the fisheries to inspect the process of handling and hatching eggs. The vessel was then transferred to the Chesapeake for the purpose of continuing shad work, where 4,500,000 eggs were obtained and 1,370,000 young fish hatched. During August the Fish

Hawk was at Saint Jerome Station assisting in the driving of piles on each side of the entrance to the new channel which had been cut. In September, after undergoing repairs at Baltimore, the vessel proceeded to Wood's Holl, where she arrived on the 27th. She remained there until the close of the year, performing such duties as were required in connection with that station.

#### C.—THE STEAMER LOOKOUT.

The Lookout was under the command of Mate James A. Smith throughout the year. From January 1 to the 4th of February the vessel was at Baltimore. On January 22 orders were issued to prepare the steamer for a trip to the Gulf coast in order to make an investigation of the fisheries of the west coast of Florida and of the Gulf of Mexico. Arriving at Cedar Keys, Florida, March 14, Assistant Commissioner Ferguson joined the vessel and thereafter directed her movements. Among the places visited were Saint Joseph, Saint Andrew's Bay, Pensacola, Key West, Apalachicola, Cedar Keys, Anclote Keys, Clear Water Harbor, Tampa, Punta Rassa, and Havana. She returned to Washington May 7, and after some repairs entered upon the shad-hatching work on the Susquehanna and Delaware Rivers, and was so occupied until June 5. During the first part of July the vessel made various trips in Chesapeake Bay, and made an examination of the Spanish-mackerel fisheries. On July 20 the Lookout arrived at Wood's Holl. On the 29th a trip was made to No Man's Land for swordfish, and on the 31st a trip was made to New Haven to obtain oysters for use in propagation at Wood's Holl. From the 12th to the 27th of August the vessel was detailed to service with Mr. E. G. Blackford, a Fish Commissioner of the State of New York, charged with investigating oyster-beds of Long Island Sound and vicinity. A trip was made with live fish from New York to Wood's Holl early in September. In October the Lookout was used to transport a large quantity of specimens to the Peabody Museum, New Haven, Conn., for investigation by Professor Verrill, after which, service was performed in Chesapeake Bay in connection with the stations located there. The close of the year found the vessel laid up in Baltimore.

#### D.—THE SCHOONER GRAMPUS.

In my report for 1884 mention was made that an appropriation of \$14,000 had been asked for from Congress to build a vessel for a special purpose—that of transporting living fish from the oceanic fishing-grounds to the main station at Wood's Holl, Mass. The possibilities of artificial propagation, so far as sea-fish are concerned, seemed almost limitless, provided an ample supply of fish, such as halibut, cod, mackerel, &c., could be obtained. It is only possible to get a supply of these by using a smack containing a well, and the possession

of such an adjunct has been considered a very important matter to the Commission.

The appropriation was made by Congress, and shortly afterwards, on his return from a cruise on the Albatross to the Gulf of Mexico, Capt. J. W. Collins began work on the model and plans for a vessel. It had been previously determined that a schooner-rigged sailing vessel of about 80 tons net register would be best adapted to the requirements of the Commission. The whole matter of designing her in all its details of model, interior arrangement, rig, &c., was placed in the hands of Captain Collins, who for several years past has made a special study of the fishing vessels of Europe and America. His studies and experiences have led him to believe that the fishing boats in use on our New England coast have heretofore been more or less faulty in model and rig for the special work which they have to perform, particularly in the winter season. Therefore, in designing this vessel for the Commission, an attempt has been made to produce a new and improved type of fishing schooner, one which would not only possess the best qualities of the clipper craft now employed in the New England fisheries, but would also be much more seaworthy. It is believed by those who have had the best opportunities for studying the question in all its bearings that the fishing schooners built during the past quarter of a century or more have generally been too shallow to insure requisite safety when exposed to gales, and that they are liable to be capsized by heavy seas. Since their center of gravity is not sufficiently low to enable them to right again, the consequence is that they have frequently filled and sunk with all on board.

The loss of life and property from this cause has on many occasions been enormous, and it is apparent that any improvement in the model of our fishing schooners which can obviate these distressing circumstances will be a great blessing to the fishing interests. The vessel designed by Captain Collins, for which the name of Grampus has been selected, has been made 2 feet deeper than the fishing schooners of the same length are usually built, and therefore should be very much safer, since her ballast can be placed lower and her stability correspondingly increased. In several other respects besides that of depth, the Grampus differs from the typical fishing schooner: First, instead of having a raking stem and a long projecting cut-water, her stem is nearly straight and perpendicular above water and curves away at an easy slope to join the keel below load-line. This is believed to be quite an important improvement, since the long cutwater, which is liable to be broken off by a heavy sea or otherwise damaged and thus become a source of constant expense, is dispensed with. At the same time, with a given length over all, the length of the load-water line is increased 4 or 5 feet at the bow; consequently the entrance can be made much easier and the buoyancy on the water-line forward increased. This change, everything else being equal, should produce a vessel that would

be swifter and dryer than one of the common forms. Second, the after section has been made different from that of the ordinary fishing craft. The run of the latter is commonly hollowed out very much, leaving the quarters and counter very flat, while the horizontal lines in this part of the vessel are generally a series of very abrupt curves. The after section of the Grampus, while preserving a general semblance to that of a fishing schooner, has much easier lines, and the stern has a greater rake, which gives it a more symmetrical appearance and will enable the boat to run easier in a seaway.

The rig of the Grampus differs from that of fishing vessels generally, n having all wire standing rigging and in carrying a fore-staysail and small jib instead of the large jib which is almost universally used. This change in the head sails makes it possible, when a vessel is obliged to reef in heavy weather, to keep the center of effort of the sails nearly in its proper place and insures the easier management of the craft.

The ship was "laid down" and her molds were made by Mr. D. J. Lawlor, of Chelsea, Mass., who is widely known as an eminent naval architect, and who also gave Captain Collins considerable mechanical assistance in the preparation of the plans, &c.

Owing to the fact that it was found necessary to have Captain Collins go off on a cruise to the Eastern fishing-banks the work of preparing the plans for the Grampus was considerably delayed. However, the plans and specifications were completed early in September and bids were advertised to be received on September 22. The number of bidders was five, their proposals ranging from \$9,300 to \$17,000, as follows :

David Clark, Kennebunkport, Me.....	\$17,000
James D. Leary, Brooklyn, N. Y.....	13,440
Arthur D. Story, Essex, Mass.....	9,500
Bishop & Murphy, Gloucester, Mass.....	9,500
Robert Palmer & Sons, Noank, Conn.....	9,300

The lowest bid was received from the firm of Robert Palmer & Sons, Noank, Conn., and the contract was awarded them, they entering into it on October 6. The bid given by Palmer & Sons was for building the hull and furnishing the spars only. A separate contract was awarded Messrs. E. L. Rowe & Son, of Gloucester, Mass., to rig the vessel and furnish her with chains, anchors, sails, and top iron-work complete for the sum of \$1,913.

Work was commenced on the vessel's hull as soon as practicable after the contract was completed, and at the close of the year reasonable progress had been made, though considerable delay had been incurred on account of inclement weather. The frame and outside planks are of oak; she is ceiled with yellow pine; fastened with copper and yellow metal below water-line and with galvanized iron elsewhere.

The well is of a unique pattern for a large smack and is specially adapted for the needs of the Commission. It is nearly in the center of

the schooner and is cone-shaped with the base at the bottom of the vessel and the apex at the deck, being what is commonly termed a "box-well." It is 16 feet long by 8 feet wide at the base, and 4 feet long by 2½ feet wide at the top, which is flush with the deck. This form of well makes it possible to reach any fish that may be in it from the deck, without difficulty, and obviates the necessity which might occur of grounding the vessel when the contents of the well are to be removed.

Besides carrying on the work which has been mentioned it has been thought desirable to have the Grampus make experimental trials with the great beam-trawl which is so extensively used in the fisheries of Europe, in order to ascertain whether this form of apparatus can be profitably employed in the commercial fisheries of the United States. To handle this properly and successfully it is necessary to have steam power. The question of what form of steam apparatus would be best adapted to this work was referred to Lieut.-Commander Z. L. Tanner, U. S. N., commanding the steamer Albatross. After due consideration he decided that a steam windlass would be the most suitable, and a contract for making the same was awarded the American Ship Windlass Company, of Providence, R. I., and the apparatus was completed early in December. Passed Asst. Eng. I. S. K. Reeves, U. S. N., consulting engineer of the Commission, has been given charge of obtaining and putting on board the steam-boiler, steam-pump, water-tanks, and the necessary piping, &c., connected with the operation of the steam apparatus and water-tanks. This work will be accomplished with as little delay as possible, and the introduction of the steam windlass apparatus will conform as nearly as may be with the completion of the vessel's hull.

#### E.—OTHER VESSELS.

In addition to the sea-going vessels already named, the Commission is provided with six steam launches, which are used either as attendants to the above-named steamers or for towing barges, transporting eggs and fish, or for miscellaneous work in connection with the stations. The list is as follows :

Albatross cutter, 26½ feet long, 7 feet beam, and 3½ feet deep.

Albatross gig, 25 feet long, 5½ feet beam, and 3½ feet deep.

Fish Hawk launch, 24½ feet long, 5¾ feet beam, and 3¾ feet deep.

Cygnets (No. 82), 33 feet long, 8½ feet beam, and 4 feet deep.

Launch No. 68, 37 feet long, 7 feet beam, and 3 feet deep.

Launch No. 55, 30 feet long, 7¾ feet beam, and 3 feet deep.

The two last-named launches are attached to the Havre de Grace Station, while the Cygnets has been in service alternately between Havre de Grace and Wood's Holl.

Launch No. 68 and launch No. 55 are the property of the Navy Department, and have been loaned to the Commission by the courtesy of the Bureau of Equipment and Recruiting.

## F.—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 April 13 the apothecary of the Fish Hawk, Mr. J. Alban Kite, resigned his place and was succeeded by G. F. Nelson, M. D., on appointment of Surgeon-General F. M. Gunnell.

On April 22 Ensigns R. H. Miner and L. M. Garrett were detached from the Albatross.

On July 31 Passed Assistant Engineer W. L. Bailie was retired from service, and Passed Assistant Engineer I. S. K. Reeves was transferred from the Fish Hawk to fill the vacancy in shore duty at Wood's Holl.

On August 17 Engineer S. H. Leonard was ordered to the Fish Hawk.

On September 30 Lieut. H. S. Waring was ordered to duty on the Albatross.

On November 4 Ensign Franklin Swift, and on November 10 Lieut. A. C. Baker, were detached from the Albatross.

On December 3 Ensign W. J. Maxwell reported on board the Fish Hawk for duty.

On December 12 Lieut. C. J. Boush was detached from the Albatross.

On December 21 Lieut. Bernard O. Scott reported for duty on the Albatross.

I regret to record the loss of the services of Passed Assistant Engineer William L. Bailie, who in February, 1884, was ordered to duty with the Commission in connection with the steam engineering work of the Wood's Holl Station, being transferred from the steamer Fish Hawk. The efficiency and completeness of the work at the station is due in large part to the ingenuity exhibited by him in planning the necessary arrangements and combinations and in carrying them out.

His services, also, in connection with the steam engineering and plumbing work of the Fish Commission cars, of the Central Station at Washington, and at the United States carp ponds, &c., have been of very great importance.

In consequence of physical disability Mr. Bailie was placed on the retired list of the Navy on July 1, 1885, which, of course, relieved him from official duty with the Commission. He, however, volunteered his services in connection with the completion of the work, and remained at the station until September 16, when he left to take up his abode in Baltimore.

## 5.—CARS OF THE U. S. FISH COMMISSION.

The history of the construction and use of these cars has been detailed in previous reports, and need not here be repeated. The cars are as follows :

No. 1, constructed in 1881, now in charge of Newton Simmons.

No. 2, constructed in 1882, now in charge of George H. H. Moore.

No. 3, constructed in 1884, now in charge of J. F. Ellis.

These cars are in active service about six months of the year. During the remainder of the time they are stored in a shed erected for the purpose near Central Station, and the crews furloughed. In all the miles of travel, now aggregating many thousand, no serious accident has ever happened to any of these cars, if we may except a slight "smash-up" in Canada a few years ago, which damaged the end of one car, but injured none of the occupants.

As has been stated on a previous page, the experiment of using a car as a temporary hatchery was tried at Lambertville, N. J., with good results.

One of the cars was displayed at the New Orleans Exhibition, with its load of fish and eggs, and excited great interest.

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

##### A.—BY THE GOVERNMENT.

**TREASURY DEPARTMENT—Secretary's Office.**—The Acting Secretary, C. S. Fairchild, granted a permit May 1 for taking seals at the Pribylov Islands. On September 5 he directed the collector of customs at the port of New York to render facilities in connection with the landing of soles imported from England for the purposes of propagation. On the 6th of November the order to the collector at New York was made general to cover all importations of fish and eggs in behalf of the United States Fish Commission.

On the 16th of December the Department issued a circular to all collectors of customs at ports where fishing vessels are documented, requesting them to co-operate with the Fish Commission in obtaining statistics of the ocean fisheries.

**Light-House Board.**—This Board has continued to assist in securing ocean-temperature observations at thirty-five light-houses and light-vessels along the Atlantic coast. A list of these light-houses will be appended to this report. On June 15 the Board granted for the summer the use of the old laboratory building at the Wood's Holl buoy department, which has been previously of much service to the Commission. With the completion of the new buildings, however, the present season is probably the last that this courtesy will be desired.

**Coast Survey.**—Frequent calls have been made upon the Coast Survey for tide-tables, maps, and charts for use on the different vessels and at the stations of the Commission, which have been supplied very courteously. On July 2 it lent a set of hydrographic charts, to be copied and used in studying the movements of mackerel, menhaden, and other fish along the coast, thus saving a large amount of original work. The Superintendent of the Survey on May 14 offered to lend the schooner *Matchless*, but it was found unnecessary to accept the offer.



*Life-Saving Service.*—As in several preceding years, the keepers and patrolmen have reported the stranding of marine animals, and co-operated with representatives of the Smithsonian Institution in securing specimens for study and exhibition. Among the valuable accessions was a pigmy sperm-whale, reported on January 1 by James R. Hobbs, keeper of Kitty Hawk, N. C.

Another accession was found on the beach near High Head L.-S. Station by Mr. B. C. Sparrow, superintendent of the Second L.-S. District, and proved to be the so called "dish-rag gourd" (*Luffa aegyptica*).

October 24 Joel Ridgway, keeper of Barnegat L.-S. Station, reported a whale (*Kogia breviceps*) ten feet long, stranded near the station.

**WAR DEPARTMENT.**—Permission to use the facilities at Fort Washington for the purpose of hatching shad has been continued during the present year.

*Signal Office.*—General Hazen has continued to furnish weather indications to Wood's Holl during the summer season, as well as to the steamer Lookout during its trip along the southern coast and the Gulf of Mexico.

**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 the facilities of various navy-yards, particularly that at Washington, have been extended to the Commission.

*Bureau of Construction and Repair.*—The launches Nos. 55 and 68 have been furnished for several years, and their loan was continued during the present year.

*Bureau of Steam Engineering.*—On November 11 Commodore Charles H. Loring granted the loan of some tools for use at Havre de Grace and at Wood's Holl.

*Bureau of Equipment and Recruiting.*—Coal was furnished to the Fish Commission vessels upon requisition, at contract prices, as in preceding years.

**INTERIOR DEPARTMENT—Patent Office.**—The Official Gazette of the Patent Office has been supplied weekly, as heretofore, and specifications and drawings of all patents relating to fish and fishing apparatus as issued.

**SENATE AND HOUSE OF REPRESENTATIVES—Folding-Rooms.**—The superintendents of the Senate and House folding-rooms kindly consented to envelop the quarto report, which was issued in two volumes December 20.

**HEALTH OFFICE OF THE DISTRICT OF COLUMBIA.**—Statistics of the Washington fish-market have been furnished in monthly tables, as in previous years. These have been compiled and published in the Fish Commission Bulletin.

B.—BY THE RAILROAD COMPANIES OF THE UNITED STATES.

The courtesies extended by the railroad managers have been: (1) The transportation of Fish Commission cars gratuitously over several

thousand miles of road; (2) the transportation of Fish Commission cars at the rate of 20 cents per mile over an even greater number of miles of road; (3) permission to carry fish and eggs in baggage-cars of passenger trains, and for the attendants to enter the cars for the purpose of caring for the fish; and (4) furnishing such repairs as have been needed to the cars at the shops of several companies, notably the Pennsylvania Railroad and the Baltimore and Ohio Railroad. A list of the roads furnishing free transportation, and also of those furnishing transportation at the 20-cent rate, will be appended to this report. It may be well to explain that the 20-cent rate is a very large reduction upon rates charged for hauling private cars. For instance, for hauling a private car from Philadelphia to Pittsburg the Pennsylvania Company would charge eighteen full fares, or \$180, while for hauling the Fish Commission car it would charge 20 cents per mile, and as the distance is 352 miles the charge would be \$70.40, which is \$109.60 less than the charge to private parties for the same service.

#### C.—BY FOREIGN STEAMSHIP COMPANIES.

The foreign steamship companies have continued their liberal treatment of the Commission by free transportation of fish and eggs. The extent to which these facilities have been furnished will be seen by reference to the list of courtesies extended to and received from foreign countries, to be stated hereafter.

#### D.—COURTESIES FROM FOREIGN COUNTRIES.

*Germany.*—On February 24 there were received from the Deutsche Fischerei-Verein 40,000 eggs of the brown trout (*Salmo fario*). From this lot, one-half of which were consigned to Mr. Blackford, about 19,000 fry were secured.

On January 30 a box of 50,000 eggs of *Coregonus albula* was received in New York and repacked by Mr. Mather and forwarded to the Bucksport Station.

On November 5 there were received by steamer Elbe 10 macropods or paradise-fish, from Paul Matte, fish-culturist, Lichterfelde, Germany. These were received in New York by Mr. Blackford, who transferred them to his aquarium in Fulton Market pending their final disposition. They had, however, been so exhausted by the journey that in a few days all had died. Mr. Matte sent these fish with the hope of procuring American ornamental fish in exchange, his collections including representatives from many parts of the world.

*England.*—Persistent efforts have been made during the present year to safely transport soles. On September 10 an installment from the National Fish Culture Association of England arrived per steamer Republic in care of Mr. W. T. Silk, but all the fish had died in the passage from Liverpool to New York.

The Marquis of Exeter, who is president of the National Fish Culture Association, had interested himself in the success of this shipment, and had kindly placed at the command of the National Fish Culture Association his private fish culturist, Mr. Silk, in order to insure the best possible results.

In his letter of September 25 Mr. W. Oldham Chambers, secretary of the National Fish Culture Association, said that complete arrangements had been made by him for catching soles on the Essex coast. They were deported from the boat at Harwich to Liverpool by special van in charge of a qualified attendant, who, on arriving at Liverpool, handed the fish over to Mr. Silk in perfect condition. Mr. Chambers further says: "I fear their loss was due to the fact that Mr. Silk placed the fish in the public baths at Liverpool, which is not only *brackish*, but full of *impurities*, naturally fatal to deep-sea fishes like soles. My council desire me to express their deep regret at the ill-fortune attending their endeavors to further the acclimatization of flat-fish in the United States, but at the same time wish me to assure you that they will take an early opportunity of renewing the experiment notwithstanding the recent failure, caused more from wrong treatment than from inherent incapacity on the part of the fish to withstand the strain of transportation."

On October 8 Mr. Thomas J. Moore, curator of Liverpool Museum, with the aid of Mr. W. A. Duncan, forwarded to Mr. E. G. Blackford 12 soles by the steamer *Britannic*, Capt. Hamilton Perry, of the White Star Line. These were received October 19 and presented to the Fish Commission. The 9 soles which reached New York alive were immediately sent to Cold Spring Harbor to be cared for until arrangements could be made to transport them to Wood's Holl in safety. From the time of arrival at Cold Spring Harbor, October 20, Mr. Mather made observations upon their habits, and reported them doing well until December 30, when the soles, together with a large installment of cod eggs, were frozen to death during a violent storm. An important feature of Mr. Moore's method was the use of six Mortimer ship aquaria containing 2 soles each. The bottom of the glass globes in which the fish were placed was covered with an inch or two of sand. The soles buried themselves therein and no chafing resulted. This shelter imitates quite well their native habitat.

On October 24 an installment of 500 soles was sent from Liverpool, by the Cunard steamer *Gallia*, in charge of Mr. William Little, of 32 Scratton Road, Southend, Essex County, England. These soles were taken off Norwich and transmitted by rail to Liverpool, where Mr. W. Oldham Chambers, secretary of the National Fish Culture Association, made arrangements for their reception and transshipment. The steamer arrived at her dock in New York on the morning of November 3. Mr. Blackford and Mr. Mather were there with a tug and suitable cans to receive them, but were greatly disappointed to find that most of the

fish had died when the steamer was only two days out, and the remainder a few days later. They had been placed in several casks, without sand upon the bottom of the vessel. Consequently the soles, lying right upon the bottom, were very much chafed at their heads and tails. Mr. Little, the attendant, was selected because he was the fisherman who had caught these soles, and he was able to give information with regard to their habits, food, and movements. As the basins at Wood's Holl had been prepared for the reception of this large shipment, and the steamer Lookout had been sent to New York to convey them to Wood's Holl, and the facilities already alluded to had been secured from the custom-house, the bitter disappointment at the loss of the entire 500 fish may be readily understood.

*Scotland.*—On January 2, 100,000 eggs of Loch Leven trout (*Salmo levenensis*) were received from Sir James Gibson Maitland, of the Howietoun fishery, Stirling, Scotland.

#### 7.—COURTESIES TO FOREIGN COUNTRIES.

Scarcely a year has passed since the organization of the Commission in which there has not been one or more transmissions of fish or eggs to foreign countries in response to requests made in behalf of their respective Governments. While in a few instances failure has resulted, the general success has been such as to lead to renewed demands. The present year has witnessed greater activity in this direction than in preceding years. As will be seen from the preceding paragraphs as well as from other reports, suitable returns have been made to the United States by several countries furnishing the Commission with fish or eggs of fish new to the United States.

The Commission has been called upon to extend courtesies to foreign countries in the way of imparting information upon the methods and success of American fish-culture, and accredited representatives of other Governments have been accorded the facilities of the office in Washington and of such stations as they chose to visit for the purpose of examination. The reports and bulletins of the Commission, notably the quarto report which appeared during the present year, have been very greatly sought by foreign fish-culturists, and so far as possible their wishes have been met. Scarcely a week has passed without receiving letters from such persons making inquiries with a view to increasing the efficiency of their work. These letters, whether received through the State Department or direct, have been answered promptly and as fully as practicable.

An interesting correspondence was held with Juan de la O. Cerda, Chilean consul-general at San Francisco, who was commissioned by the Chilean Government to secure California salmon eggs for Chili. The Chilean Government called upon this Commission to recommend a suitable person to take charge of the introduction of salmon into Chili, and it gave me much pleasure to nominate Mr. Livingston Stone. The

year closed without any decisive answer having been received to Mr. Stone's proposition. A statement of what is hoped to be accomplished by the Chilean Government will be found in the Fish Commission Bulletin of 1885, page 247.

There has been considerable correspondence with a view to transmitting shad to Holland, but the apparatus for accomplishing this result with so delicate a species has not yet been perfected sufficiently to warrant making the effort.

The species covered by the transmission of fish or eggs of the present year include whitefish, rainbow trout, brook trout, Penobscot salmon, landlocked salmon, catfish, carp, bass, red-eye perch, and suckers.

The list of countries to which transmissions have been made includes Australia, Brazil, Canada, England, France, Germany, Mexico, The Netherlands, Scotland, and Switzerland.

*Australia.*—On January 5 there was forwarded from the Northville Station, in charge of special messenger as far as Council Bluffs, 1,000,000 whitefish eggs, consigned to the Ballarat Acclimatization Society, W. P. Whitcombe, president. The eggs were received in San Francisco by Mr. Robert J. Creighton, agent for the New Zealand Government, who placed them safely on board the Pacific mail steamer. His son, Mr. Charles Creighton, reported that the eggs reached Sydney in good condition, but while on the steamer plying between Sydney and Melbourne they were subjected to a rise in temperature which destroyed the entire lot before reaching their destination.

*Brazil.*—On March 28, 100 carp were sent to Preston A. Rambo, care of John C. Uhler, M. D., Baltimore, who left for Rio Janeiro March 30. The carp were from one to two inches in length, and being in charge of an attendant doubtless reached their destination in good condition, although nothing definite has been heard.

*Canada.*—During December of the present year applications for carp were received from twenty residents of the Dominion of Canada. As it was too late to supply them in 1885 the applications were held over for consideration in 1886.

*England.*—Eggs of whitefish, lake trout, Atlantic or Penobscot salmon, brook trout, landlocked salmon, and rainbow trout have been sent to Great Britain during the present year, the transportation being furnished free of charge by the Cunard Line.

The following shipments have been made to the National Fish Culture Association, South Kensington, London, England, care of Hon. Edward Birkbeck, M. P., vice-president of the association: On January 14, 250,000 eggs of the whitefish and 30,000 eggs of the lake trout were shipped by steamer Gallia, Mr. W. Oldham Chambers, secretary to the association, under date of February 10, announcing the arrival of the eggs in excellent condition, the rate of mortality being remarkably low. On February 4, 30,000 eggs of the Atlantic or Penobscot salmon were shipped by steamer Scythia, these also arriving in excellent

condition, the death rate being under 1 per cent: On February 11, 25,000 brook trout eggs were sent by steamer Servia, their safe arrival being announced February 25. On March 27, 30,000 landlocked salmon eggs were transported by steamer Bothnia, and on April 18, 5,000 rainbow trout eggs were sent by steamer Servia. Mr. W. Oldham Chambers, in presenting the thanks of the association for the salmon and trout forwarded during the present year, reports that they "were hatched out at South Kensington with a very low minimum of mortality, and the fry were in due course transferred to our fish-culture establishment at Delaford Park, where they continue to thrive."

On October 20, 1885, Mr. W. Oldham Chambers wrote, "The propagation of whitefish this year having proved such a great success, we are particularly desirous of making a special feature of this species next year."

On the 11th of April a consignment of 10,000 rainbow trout eggs was sent by steamer Devonia, of the Anchor Line, to the same address. These also arrived in good order.

Concerning the above, Land and Water of February 28, 1885, says:

Foremost among the most interesting consignments of eggs which have been received from abroad are a large number of ova of various kinds forwarded by the American Government, through their Fishery Commissioner, Professor Baird. The United States Government has been most liberal in its presents of fish eggs, and English pisciculturists owe it a hearty vote of thanks for giving the National Fish Culture Association an opportunity of carrying on experiments with a view of ascertaining whether the introduction of certain fish from American waters into our English, Irish, and Scotch rivers and lakes can be practically and advantageously carried out.

On June 20 there were sent by the steamer Britannic, of the White Star Line, 50 catfish to the National Fish Culture Association. Under date of July 10 the secretary, W. Oldham Chambers, stated that 48 had arrived in safety and been placed in the establishment at Delaford Park. The London Globe of July 11 notices the fact and pronounces them of great economic value.

In October Mr. W. T. Silk, who had accompanied the consignment of soles already referred to, took back with him to England, for the Marquis of Exeter, 250 black bass and 50 red-eye perch, and for the National Fish Culture Aquaria at South Kensington, 20 suckers, all of which had been forwarded from the Wytheville Station.

*France.*—On March 1, a package of 10,000 rainbow trout eggs from Wytheville Station reached New York. These were presented to Mr. E. G. Blackford, who forwarded them to the Society of Acclimatization, Paris.

By steamer Amérique, on July 18, Mr. Blackford sent six cans containing 100 catfish (*Amiurus nebulosus*) to Havre. Of these 50 were forwarded to W. Coleman Burns, who received them at Paris in excellent condition. The other 50 were for the Society of Acclimatization, whose secretary reported under date of July 29, the receipt, in perfect condition, of 41 specimens.

*Germany.*—During the present year the eggs of whitefish, brook trout, landlocked salmon, and rainbow trout have been shipped to Herr von Behr, president of the Deutsche Fischerei-Verein, care of Mr. Busse, of Geestemünde, by the North German Lloyd Steamship Company. This line transported the eggs free of charge. I regret to say that three consignments intrusted to the steamer Eider arrived in bad, if not totally worthless, condition. As a rule this company has been successful with the eggs committed to its care.

On January 10, 1,000,000 whitefish eggs were shipped by the steamer Salier, the eggs arriving in Geestemünde in good order, but by some misunderstanding half of them were shipped from there to Switzerland. An additional lot of 1,000,000 whitefish eggs was sent on February 20 by the steamer Eider, but arrived in bad condition. On reaching Geestemünde no ice was found in the boxes.

The 40,000 brook-trout eggs shipped on February 7 were well cared for by the steamer Fulda and arrived at Geestemünde in good order.

On the 30th of March a lot of 40,000 landlocked salmon eggs and 10,000 rainbow trout eggs were shipped by steamer Eider. As was the case with the whitefish eggs shipped on the 20th of February, there was a lack of ice in the boxes and all of the rainbow trout and nearly all of the landlocked salmon were lost. Mr. F. Busse, of Geestemünde, under date of April 12, 1885, reports that the consignment of fish eggs arrived without any ice whatever, even the boxes being dry. The *Salmo irideus* had actually decayed, and not a single egg could be distinguished on the frames. The landlocked salmon on their arrival were found to be considerably developed, some young fish having already slipped out of the eggs.

On June 16, 50 live catfish were sent to the Deutsche Fischerei-Verein by steamer Ems. On July 17 Count Max von dem Borne reported that 49 had arrived safely at Berneuchen.

The last-named gentleman having expressed a desire to introduce into the fish-ponds of Berneuchen the wild-rice (*Zizania aquatica*), a bushel was obtained from Valentine Brothers, Janesville, Wis., and forwarded to him. On September 7 he reported that the seeds failed to germinate.

*Mexico.*—On March 14 the Fish Commission representative at New Orleans delivered to Dr. Barroeta a pail of 25 carp, to be taken by him to Mexico, the smallest and strongest carp of the different varieties being selected.

On April 6 Dr. Barroeta reported that 14 reached their destination alive. On that date he forwarded a second installment. On October 13 Señor Esteban Chazari, of the City of Mexico, made a request for carp and lake trout eggs. Carp four months old to the number of 800 were forwarded by Wells, Fargo & Co.'s Express, via El Paso, Tex., on the 4th of December, and on the 26th Mr. Chazari received them in

good condition. On January 18, 1886, 25,000 lake trout eggs were forwarded to him, but were unfortunately received in poor condition.

*The Netherlands.*—On March 10 Mr. E. G. Blackford forwarded 5 black bass to Dr. C. Kerbert by steamer Edam, Captain Taat. On April 8 Dr. Kerbert reported their safe arrival. On July 7 Dr. Kerbert acknowledged the receipt of 30 catfish which had also been sent by steamer Edam through the assistance of Mr. Blackford.

*Scotland.*—On April 4, 20,000 landlocked salmon eggs were forwarded to the Tay District Salmon Board, care of John Anderson & Son, Edinburgh, by steamer State of Pennsylvania, of the State Line. A very courteous letter of thanks was received from Vice-Admiral W. H. Maitland Dougall, R. N., writing in behalf of the Tay District Salmon Board, but definite statements concerning the condition of the eggs on arrival are lacking. On April 18, 10,000 rainbow trout eggs were shipped by steamer Devonian, of the Anchor Line, to Sir James Gibson Maitland, of the Howietoun fishery. These arrived in good condition.

*Switzerland.*—As has already been stated, one-half of the million whitefish eggs sent January 8 to the Deutsche Fischerei-Verein were forwarded to Switzerland. Under date of February 19 the Swiss minister, Hon. Emil Frey, stated that the eggs reached Berne in fine condition and had been distributed to hatcheries at Zurich, 50,000; Berne, 100,000; Lucerne, 50,000; Zug, 50,000; Grisons, 100,000; Vand, 100,000; and Geneva, 50,000.

#### 8.—SERVICES RENDERED TO OTHERS.

On the night of Saturday, September 5, the steamer Monohanset, belonging to the New Bedford, Vineyard and Nantucket Steamboat Company, ran aground on a bar in the Great Harbor at Wood's Holl, about 200 yards from the railroad depot. The occurrence took place about 11 o'clock at night, and the vessel had on board about five hundred passengers, who had been to Cottage City to witness the annual illumination, and who were to take a train about midnight to Hyannis.

Although there was no danger in the occurrence, the probability of a long detention through the night was not comfortable to contemplate, and the case having been brought to my notice I authorized and directed the steamer Lookout and the steam launch, having a large scow in tow, to proceed at once to the scene. In two trips of the vessels the entire party was landed on the dock; and the cars being rapidly filled, the train proceeded to its destination.

The company, appreciating the services rendered, transmitted the following communication:

NEW BEDFORD, September 7, 1885.

DEAR SIR: Please accept our thanks for the valuable service rendered us in landing the passengers (something over four hundred) from the steamer Monohanset, ashore at Wood's Holl Saturday night, and for other assistance rendered. It was a rainy and disagreeable night, and it was a great relief to the large number of passen-



gers when you came to their aid, taking them from the steamer and landing them on the wharf at Wood's Holl safe at midnight.

If we can hereafter serve you in any way please advise us, as we desire to show our appreciation for what you have done for us.

Very respectfully yours,

EDW. T. PIERCE,  
*Agent.*

Prof. S. F. BAIRD,  
*U. S. Fish Commission, Wood's Holl.*

9.—PARTICIPATION IN INTERNATIONAL EXHIBITIONS.

A.—LONDON, 1883.

The history of our connection with the great International Fisheries Exhibition, at London, has already been given in preceding reports. In 1885 the medals and diplomas which had been awarded to the U. S. Fish Commission arrived, the list of which is as follows:

- Rigged models of fishing-vessels: Gold medal.
- Mackerel and herring nets: Diploma.
- Exhibit of artificial flies: Gold medal.
- Fish transporting car: Silver medal.
- Model of lobster-boiling establishment: Gold medal.
- Collection of piscicultural exhibits: Gold medal.
- Collective exhibit of invertebrata: Gold medal.
- Whale-bone: Gold medal.
- Enlargement of photographs and drawings illustrating fishing pursuits: Gold medal.
- Collection of primitive fishing tackle, modern sea-fishing lines, gear, and hooks: Gold medal.
- Collective exhibit of publications relating to the fisheries: Gold medal.
- Herring smoke-house, collective exhibit of appliances: Silver medal.
- Model of menhaden oil and guano factory: Gold medal.
- Collection of oils, &c.: Gold medal.
- Collective exhibit of fishery products: Gold medal.
- General exhibit of fish-eating birds and mammals: Gold medal.
- Collection of dredge exhibits: Silver medal.
- Photographs of fish-culture: Silver medal.
- Collective exhibit of deep-sea exploration apparatus: Gold medal.
- Collective exhibit of boats: Gold medal.
- Builders' models of fishing vessels: Gold medal.
- Purse-seine net: Gold medal.
- Collection of dry-salted fish: Diploma.
- Collective exhibit of fish: Gold medal.

B.—NEW ORLEANS, 1885.

The U. S. Fish Commission, in 1885, participated in the World's Industrial and Cotton Centennial Exposition at New Orleans, sending exhibits to illustrate the fisheries, fish-culture, and deep-sea research.

The Board of Government Commissioners, appointed by the President in 1884 to make arrangements for a general Government display at the Louisville, Cincinnati, and New Orleans exhibitions, included Mr. G.

Brown Goode, Assistant Director of the U. S. National Museum, who was charged with the preparation of an exhibit from the Smithsonian Institution, the National Museum, and the U. S. Fish Commission.

In the fall of 1884 the collections were shipped from Washington and duly installed at New Orleans soon after the opening on December 16, 1884. The exposition continued till May 31, 1885. Mr. Goode being obliged to return to Washington, the care of the collection was given to Mr. R. Edward Earll, of the Fish Commission, who was assisted by Colonel McDonald and others.

The exhibit of fisheries and fish-culture occupied 2,345 square feet of the 24,750 square feet allotted in the Government buildings to the general display of the Smithsonian, National Museum, and Fish Commission. The collection included some of the exhibits which had previously done service at Berlin and London. Among the objects displayed were about one hundred and fifty photographs, size 30 by 40 inches, illustrating the apparatus and methods employed in the sea and river fisheries of this country, and a collection of models in plaster of the principal fresh and salt-water food-fishes of the United States.

A series of diagrams and tabulated statements, prepared by Prof. W. O. Atwater, showed in an instructive manner the relative food qualities of the leading food-fishes compared with other foods.

A full-sized whale-boat, with complete outfit ready for the chase, was an attractive exhibit.

Colonel Marshall McDonald, of the U. S. Fish Commission, had the direction of the fish-cultural exhibit, which consisted of a series of six tables containing hatching apparatus in which the embryos of white-fish, salmon, and other species were kept during their development, and small aquaria in which the newly hatched fry were exhibited. There were also six large aquaria containing trout, salmon, carp, and several other species of fish from the Fish Commission ponds at Washington. There was also a series containing numerous forms of hatching apparatus used at the hatcheries of the U. S. Fish Commission, and models of various kinds of fish-ladders or fishways.

Arrangements were made with the management of the exposition for a supply of pure water for conducting the hatching operations, and at intervals during the continuance of the exposition, eggs of different species were shipped to New Orleans and placed in the hatching apparatus, where they were allowed to remain until hatched. This exhibit was perhaps the most popular in the entire exhibition, and during the time when clear water could be obtained, and the young fish were hatching, a majority of the people attending the exposition found their way to the space, some of them lingering hour after hour.

On February 18 Colonel McDonald arrived with U. S. Fish Commission Car No. 3, containing a full equipment of hatching and transporting apparatus. This car was placed on a side track at the Prytania street entrance of the exhibition adjacent to the Smithsonian space,

and was constantly open for inspection from 8 in the morning until 6 in the evening. In it were shown, not only the processes of hatching, but the methods employed in transferring the fry to waters very remote from the hatchery. After the fish-cultural exhibition had been installed Colonel McDonald returned to Washington, and J. Frank Ellis was placed in charge of the car, and James Carswell assumed control of the fish-cultural display in the Smithsonian space in the Government building. The car remained until the middle of May, when it was recalled to be used in the distribution of shad from the Fish Commission hatcheries in Washington and Maryland.

The Fish Commission steamer *Albatross* was engaged during the winter of 1884-'85 in scientific investigation of the currents, temperatures, and marine life in the vicinity of the West Indies and in portions of the Gulf of Mexico. She was stationed for a few days at New Orleans. On her arrival in that city the exposition management placed a portion of the exposition wharf at her disposal. She soon occupied the place assigned, and was thrown open for inspection by persons visiting the exposition as a part of the exhibit of the U. S. Fish Commission. The apparatus employed in her scientific investigations was arranged on deck, and interesting forms of marine life recently taken in the deep waters of the Gulf of Mexico were removed from the tanks and placed in glass bottles in the steamer's laboratory, where they could be viewed by those who might be interested. At the request of Capt. Z. L. Tanner, an efficient corps of officers and scientists remained constantly on duty to inform visitors of the general character of the work in which the steamer was engaged, and to explain the workings of the apparatus. After a stay of ten days, during which time she was visited by a very large number of people, she left the exposition in order to resume her work, which had been temporarily interrupted.

#### 10.—MEETING OF THE AMERICAN FISHERIES SOCIETY.

The fourteenth annual meeting of the American Fisheries Society (formerly known as the American Fish-Cultural Association) was held at the National Museum in Washington, D. C., on May 5 and 6, 1885, under the presidency of Hon. Theodore Lyman, of Massachusetts. During the meeting twenty-seven names of gentlemen were proposed and elected to membership.

The first paper read was by Prof. Robert E. O. Stearns, on "The giant clams of Puget Sound," in which the habits, size, and edible qualities of the geoduck clam (*Glycymeris generosa*) were described. This was followed by a paper on the "Hibernation of the black bass," by Dr. James A. Henshall, in which he held that the hibernation of fishes is influenced more by the supply of food than by temperature, and that both species of black bass hibernate in the northern sections of America. Mr. Fred Mather presented a paper on "Protecting and hatching the smelt," which contained some interesting statements regarding the

habits of the smelt, and showing some of his experience in procuring and handling the eggs. Mr. Frederick W. True read a paper on "The porpoise fishery of Cape Hatteras," in which he stated the objects to be pursued by a company recently organized in Philadelphia for the capture of porpoises near Cape Hatteras, in order to utilize these dolphins for producing oil, leather, and food. It may be noted that a considerable variety of opinions was expressed in the society regarding porpoise flesh as a food product, some holding it excellent when properly smoked and others maintaining that it is a very inferior article of food. Later in the season Mr. True ate some broiled steak cut from a young porpoise brought in by the steamer Albatross, and expressed himself as very favorably impressed by the edible qualities of this young cetacean.

In the first paper read on the morning of May 6 Mr. Frank N. Clark stated the "Results of planting whitefish in Lake Erie," and showed by testimony from many reliable fishermen and fish-dealers that while the aggregate catch is steadily increasing, so also are the whitefish on the increase in Lake Erie, and that this increase is due solely to the work of the hatcheries. The next paper was by Mr. J. S. Van Cleef, on "How to restore our trout streams," in which he showed that the destruction of the trees bordering on the streams and the changed condition of the banks produced thereby has resulted in depriving the trout of their natural hiding-places, and that this is the main cause of their depletion, in connection with excessive fishing with nets and hooks and lines. Mr. A. N. Cheney next discussed the question "Does transplanting affect the food or game qualities of certain fishes?" stating his opinion that fish in alien waters improve in food and game qualities only when they find better food or water, which causes a more vigorous condition. Then followed a paper by Mr. John A. Ryder "On some of the protective contrivances developed by and in connection with the ova of various species of fishes," giving some matter of considerable biologic value. Prof. Otis T. Mason next read a short paper on "The use of the throwing-stick by the Esquimaux," several specimens being shown, their use described, and the statement made that this implement is in use only in Australia, South America, and among the Esquimaux of North America. This was followed by a valuable contribution from Prof. Theodore Gill, entitled "The chief characteristics of the North American fish fauna." In this he considered only the fresh-water forms of America north of Mexico, stating that they numbered over six hundred species, representing nearly one hundred and fifty genera and about thirty-four families; and he concluded that the number of genera and types common to Europe and North America is comparatively small, while the special peculiarities of the North American fishes are sufficient to entitle this region to be considered as a primary geographical division of the globe.

The next paper in order was on "Some objective points in fish-culture," by Col. M. McDonald. This discussed what yet remains to

be done in the way of intelligent and progressive fish-culture, speaking of the great value of scientific investigations, the need for competent legislation on the fisheries, and the practical worth to the Government of complete statistics, especially in relation to the sea fisheries. Mr. W. V. Cox followed with "A glance at Billingsgate," which gave an excellent description of that famous old fish-market, and ended with the conclusion that there is little, if anything, for American fish-dealers to learn at Billingsgate, except how far in advance of them in this respect we are on this side of the Atlantic. A paper was then read by Mr. E. G. Blackford on "The oyster-beds of New York," in which he spoke of the investigation in progress under his charge during the past year and the present condition of the oyster areas of the State. This investigation showed that the natural oyster-beds were in bad condition and much less in extent than they were twenty years ago, but that the loss in the natural areas was more than made up in the formation of planted beds, which increase the territory upon which oysters are grown, so that the number of oysters sent to market is three or four times what it was a score of years ago. The pollution of the water and the consequent destruction of the oyster-beds in the vicinity of New York City was referred to, and a plan was spoken of whereby individual owners may hold small areas of oyster-grounds and work them thoroughly.

Mr. Charles G. Atkins reported on "The biennial spawning of salmon," as learned from experiments conducted at Bucksport, Me. These seem to indicate that it is the normal habit of the Penobscot salmon to spawn every second year, while it seems to be fairly well established that a large part, perhaps nearly all, of the salmon, instead of proceeding to sea at once after spawning, linger in the fresh water all winter and descend only with the spring floods. The concluding paper was by Mr. Fred Mather on the "Work at Cold Spring Harbor," which gave a sketch of the operations at this hatchery with foreign and domestic fish during the season of 1884-'85. The facts stated are included in the Reports of the U. S. Fish Commission for 1884 and 1885.

Before the final adjournment the members of the society went to the White House and were presented to President Cleveland. A visit was also made to the Government carp ponds, near the Washington Monument.

On May 7 the society made a trip to the shad-hatching grounds of the Potomac, on the Fish Commission steamer Fish Hawk. At Fort Washington 4,000,000 eggs were exhibited in process of packing for shipment to the central station at Washington. On the homeward trip a meeting of the executive committee was held, at which it was decided to hold the next annual meeting in Chicago.

The following gentlemen were elected as officers of the society for the ensuing year:

*President.*—Col. M. McDonald, of Berryville, Va.

*Vice-president.*—Dr. W. M. Hudson, of Hartford, Conn.

XLVIII REPORT OF COMMISSIONER OF FISH AND FISHERIES.

*Treasurer.*—E. G. Blackford, of Brooklyn, N. Y.

*Recording secretary.*—Fred Mather, of Cold Spring Harbor, N. Y.

*Corresponding secretary.*—W. V. Cox, of Washington, D. C.

The members of the executive committee are as follows:

Prof. G. Brown Goode, of Washington, D. C.

Roland Redmond, of New York, N. Y.

George S. Page, of Stanley, N. J.

W. L. May, of Fremont, Nebr.

Frank N. Clark, of Northville, Mich.

Dr. James A. Henshall, of Cynthiana, Ky.

S. G. Worth, of Raleigh, N. C.

11.—PUBLICATIONS IN 1885.

*Reports.*—The report for 1883 (Vol. XI) was completed, and much progress made upon the report for 1884 (Vol. XII) during the present year.

The printing of the report for 1885 (Vol. XIII) having been ordered by joint resolution of Congress March 2, 1885, several monographs were handed to the Public Printer, including a Catalogue of the Fishes of North America, by Prof. D. S. Jordan, of which extra copies were printed for immediate distribution.

The first section of the quarto report on the Fishing Industries of the United States was issued in two volumes, one of text and one of plates, in December of the present year. In addition to the copies distributed by the Commission and by members of Congress, a considerable number have been purchased by interested persons from the Public Printer at the low price of \$2.45 for both volumes, Congress having made provision therefor in the resolution ordering the printing.

*Bulletins.*—The bulletin for the current year (Vol. V) was commenced promptly at the beginning of the year, the first signature bearing date of January 19, 1885; and sets of signatures were mailed to foreign and domestic correspondents March 12, August 22, September 5, October 20, and November 7. At the latter date the entire volume was in type, and there only remained the press-work and binding of the regular edition. This was completed and the edition distributed in March, 1886.

*Pamphlets.*—Six papers have been issued in pamphlet form during the year, as follows:

90. SHUFELDT, R. W. The osteology of *Amia calva*: including certain special references to the skeleton of Teleosteans.

[From Report for 1883, pp. 747-878.]

91. RYDER, J. A., and M. PUYSEGUR. Papers on the development and greening of the oyster.

[From Report for 1882, pp. 763-805.]

92. GOODE, G. BROWN. The first decade of the U. S. Fish Commission: its plan of work and accomplished results, scientific and economical.

[From Report for 1880, pp. 53-62.]

93. COLLINS, J. W. Specifications for building a schooner-smack.

[Printed by Rockwell & Churchill, Boston, Mass.]

94. JORDAN, DAVID STARR. A catalogue of the fishes known to inhabit the waters of North America north of the Tropic of Cancer, with notes on the species discovered in 1883 and 1884.

[From Report for 1885, pp. 769-974.]

95. BAIRD, SPENCER F. Report of the Commissioner for 1883. A.—Inquiry into the decrease of food-fishes. B.—The propagation of food-fishes in the waters of the United States.

[From Report for 1883, pp. xvii-xcv.]

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

During the year Mr. Chas. W. Smiley, as heretofore, 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.

This station, which is second only in importance to the headquarters at Washington, and which is the center of all work of the Commission connected with the propagation and investigation of marine fishes and invertebrates, has always received especial mention in the reports of the Commission, so as to place fully on record its rise, progress, and current condition. Here, alone, in the United States, opportunities occur for studying marine fish in their natural conditions, by placing them in large basins or aquaria, and for testing the period of their spawning, the nature of their food, their relationships to other life of the sea, &c.

Congress has manifested a disposition to allow the experiment to be tried on a satisfactory scale, and, from time to time, has made liberal appropriations, the total amount of money appropriated for buildings and their equipment amounting to \$70,000.

Previous reports have recorded the construction of buildings for the offices and quarters of the Commission, and for the accommodation of the pumps and tanks; also the commencement of the laboratory building, in which to carry on the work of hatching and investigation. This building was finished in February, and turned over to the Commission by the contractor, Mr. Brightman, of New Bedford, Mass., after which it was appropriately fitted up for its purpose.

The completion of the stone work of the harbor of refuge during 1884 has already been recorded in a previous report. This was done under

the direction of Col. George H. Elliot, of the U. S. Engineers, from an appropriation for the purpose made in the river and harbor bill.

The wharfing necessary to complete this work was commenced in the spring of the present year, and as much of the same was finished as the appropriations would permit, this comprising the wharf on the western side of the pier wall, the cross wharf dividing the large inclosure into two distinct basins, and the coal wharf along the southwest retaining wall. A cut of 30 feet was left in the wharf and pier on the western side in order to permit the entrance into the northern basin, a safe harbor, of vessels of the size of the Fish Hawk; and a swinging bridge across this cut was constructed for the Commission by Messrs. Brown & Lucius, of Hoboken, N. J.

On the completion of the work of the U. S. Engineer, provision was made for the erection of a coal-shed, the contract for building the foundations for which was given to Messrs. Molthorp & Co., the constructors of the wharf under the direction of the Engineer Bureau. Subsequently, the shed itself, a building 40 by 42 feet, to accommodate about 400 tons of coal, was erected by Mr. Burdick. The erection of a fence, inclosing the property, finished the work for the year, leaving unconstructed, of the whole series of buildings, only a warehouse, 30 by 60 feet, to be built in 1886.

The laboratory building was occupied during the summer by the Commissioner and his staff, for the purpose of prosecuting special investigations in connection with the habits and development of fishes and other marine animals; and, as usual, a large number of specialists of distinction spent more or less time in assisting in the work.

The laboratory building was in charge of Prof. A. E. Verrill, the other biologists in attendance being Mr. Richard Rathbun, Prof. Sidney I. Smith, Mr. Sanderson Smith, Professor Linton, Prof. B. F. Koons, Dr. Harrison Allen, Prof. William Libbey, jr., and Prof. Walter Heape, of Cambridge, England.

The deep-sea fishes collected by the Commission were brought from Washington, and arranged for the action of Dr. Bean and Mr. Goode, who made a monographic examination of the whole series.

During the summer the Albatross made a number of trips to various points in the Atlantic Ocean, bringing back many collections of much interest. For fuller information on this subject I refer to the report, in which the work of the Albatross is given in detail.

In the month of June Mr. G. H. H. Moore was sent out by the Commission with his car to transport a lot of young shad to the waters of Washington Territory and Oregon. While there he took occasion to secure a large number of the *Tapes staminea*, an excellent bivalve mollusk, which he was directed to bring back to Wood's Holl. The weather, however, being very hot, quite a number died on the passage; but he succeeded in delivering several hundred in fairly good condition, which were planted in various localities in the vicinity of the station. Should



these survive and multiply, a very important element will be added to the food resources of the Atlantic coast. There are other species which it is proposed to transport in a similar manner, but the experiment will be made in cooler weather, with better hope of success.

The account of the hatching of codfish and the methods of obtaining the parent fish are given in the report for 1884.

During the summer Mr. John A. Ryder made repeated experiments in regard to obtaining and developing the eggs of the oyster, and with fairly good success, using the special ponds constructed under his direction on grounds belonging to Dr. J. H. and Mr. Camillus Kidder. Many important facts of progress were noted in this connection, and we have good reason to hope for further success in the future.

### 13.—VISITS FROM FOREIGN SPECIALISTS.

In June of the present year Mr. J. K. Uchimura, a member of the Japanese Fisheries Society, visited the Wood's Holl and Gloucester stations for the purpose of examining the Fish Commission work. Mr. Uchimura is a graduate of the Sapporo Agricultural College, and took great interest in the biological and scientific phases of our fisheries.

In July Mr. Walter Heape, of the Marine Biological Association, Cambridge, England, visited the Wood's Holl, Bucksport, Northville, and Washington stations of the Commission, and was deeply interested, especially in the work carried on at Wood's Holl.

Mr. W. T. Silk, fish-culturist of Lord Exeter, representing in his mission the National Fish Culture Association of England, arrived in New York September 10. Reference has already been made in the proper place to the attempt to send by him an installment of soles. Mr. Silk remained in this country several weeks for the purpose of examining the fisheries and obtaining young fish to carry to England. On his return in October the Commission contributed several kinds of fish for him to take with him to England.

In December Dr. Filip Trybom, of the Swedish Fresh-water Fisheries Commission, Stockholm, was introduced to the Commission by Christian Bors, royal Swedish and Norwegian consul at New York. Dr. Trybom indicated his intention of remaining in the United States about nine months for the purpose of studying our fisheries and all their leading features.

### 14.—ICELAND HALIBUT FISHERY.

The success which attended the halibut fishery at Iceland in 1884, induced a larger number of vessels to engage in it this year (1885). Six schooners started from Gloucester to Iceland. They were the Concord, Captain Dago; Alice M. Williams, Captain Pendleton; the David A. Story, Captain Ryan (which three schooners formed the fleet to Iceland in 1884); the Marguerite, Captain Johnstone; the Lizzie H. Haskell, Captain Marshall; and the Carrier Dove, Captain Cousins.

Unfortunately, the stranding of the Concord near Arichat, Cape Breton, whereby her voyage was broken up, and the loss of the Alice M. Williams off Iceland, when just on the eve of sailing for home, were serious drawbacks to the complete success of the fleet.

Although the weather was unusually severe and the presence of ice close in to Cape North for several days interfered with fishing, halibut were so abundant that large catches were obtained, and all that returned home brought full fares, with the single exception of the Marguerite. She started from Gloucester some time after the other vessels and arrived in Iceland so late in the season (June 1) that she could fish only a short time before the weather grew too boisterous to stay on the bank. Her captain reported having found excellent fishing whenever the weather was suitable to carry on operations. On one occasion he estimates that his crew caught 50,000 pounds of halibut from a single set of the trawl-lines. During the month of June alone the Marguerite caught 80,000 pounds of fitched halibut.

The banks about Iceland afford our fishermen richer returns in the salt-halibut fishery than can be obtained elsewhere. It seems safe to predict that this new field for their enterprise, which was brought to their notice by the Commission, will be worked in the future, as in the past two years, with satisfactory results. This is all the more gratifying, too, in view of the marked depletion of the halibut on the old grounds and the practical failure of the supply from which we have been accustomed to obtain the fish used for smoking.

#### 15.—SMOKED KINGFISH.

As a part of the practical work of the U. S. Fish Commission, the opportunity occasionally arises to introduce to fish-dealers, and through them to the general public, a new variety of food-fish, or to investigate and recommend new methods by means of which fish can be prepared for the markets. Such work is clearly in the interest of both producers and consumers, and even when nothing of great consequence comes from it, it at least adds to our knowledge and resources. In illustration of this the Commission caused experiments to be made in preparing kingfish by smoking, and then tested their edible qualities when so prepared. After concluding and announcing such experiments, it must be left to interested parties to develop a new industry, or to make such use of it as may be desirable or necessary.

Kingfish from off Key West are to a limited extent found in the markets of the large cities during the winter, and are well liked as a fresh fish. The favorite ground for catching them is in the vicinity of Sombrero Key, in which region kingfish are usually very abundant from November to April.\* The method of fishing is by trail-lines, at which,

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\* For fuller information in regard to this fishery, see article by Capt. J. W. Collins on Gulf fisheries, in the appendix of this volume, p. 267.

under favorable circumstances, these large, gamy, and vigorous fish bite readily, and it sometimes happens that a boat will take a fare of 200 or 250 fish, some weighing from 20 to 30 pounds (the average weight being about 10 pounds), in a day. As a rule, the great bulk of the catch is disposed of fresh at Key West, though occasionally some fish are salted on the boats, and sometimes small quantities are salted and dried on shore in a rather primitive manner. Cured in this way it makes tolerably good food; but the texture and the oil contained in its flesh suggested that it might make an excellent article of commerce when smoked. The fact that it is seemingly abundant, and can be bought at a comparatively low figure, the average wholesale price not exceeding 2 cents per pound for fresh fish, favors its introduction as an additional article of smoked food, in which form it could be introduced all over the country, thus relieving the fishermen of their present dependence on the Cuban and local markets.

While the Fish Commission steamer Albatross was at Key West in the latter part of March, a considerable quantity of kingfish was obtained, and after being split and salted the fish were brought North by the Albatross, reaching Washington on April 6, from which point they were at once forwarded to Gloucester, Mass., to be smoked. The Commission is indebted to Messrs. William H. Wouson & Son for smoking free of charge this possible rival to smoked halibut, and for the great pains they took to have it cured in the best possible manner.

The samples were caught after the proper season for their catch was over and during the opening part of their spawning season; and some of the fish in consequence were in poor condition, while during the winter they are rarely poor. They proved, however, to be an excellent smoked fish, being tested by many experts, some of whom pronounced them equal or even superior to smoked halibut or salmon, being free from the rather rank taste that the halibut sometimes has.

#### 16.—CHEMICAL COMPOSITION AND NUTRITIVE VALUE OF FISH.

The report of the Commissioner for 1883 contains a brief account of a portion of an investigation which has been conducted by Prof. W. O. Atwater, in part at Wesleyan University and in part in Europe, upon the chemical composition and nutritive values of American food-fishes and invertebrates. The whole investigation is much more extended than this report implies, and includes not only chemical analyses of the flesh of nearly two hundred specimens of American food-fishes and invertebrates and a considerable number of other analyses, but also more abstract studies upon the constitution of the flesh of fishes. During the past year the investigation has been continued in the latter direction, this branch of the subject being important not only in its bearing upon chemical physiology but also upon the food values of the substances. The research has already attained a magnitude far greater than that of any other of the kind which has been attempted in this country or in

Europe. While Professor Atwater regards what has been done as only the beginning of a much needed research, the results already obtained throw a great deal of light upon the chemical nature and nutritive uses of fish and fish prepared for food, matters hitherto but very imperfectly understood. A monograph, embodying detailed results of this investigation and including with it those of other work in similar directions, is now nearly completed, and will not only give a large number of facts of use to the specialist, but also a very considerable amount of information of practical value, and in such form that it may be easily made use of by all intelligent readers.

The following statements by Professor Atwater are of interest in this connection :

“The chief uses of fish as food are (1) as an economical source of nutriment, and (2) to supply the demand for variety in diet, which increases with the advance of civilization and culture.

“As nutriment, the place of fish is that of a supplement to vegetable foods, the most of which, as wheat, rye, maize, rice, potatoes, &c., are deficient in protein, the chief nutrient of fish.

“The so-called nitrogenous extractives contained in small quantities in fish as in other animal foods are doubtless useful in nutrition. The theory that fish is especially valuable for brain-food, on account of an assumed richness in phosphorus, is not sustained by the facts of either chemistry or physiology.

“It is an interesting fact that the poorer classes of people and communities almost universally select those foods which chemical analysis shows to supply the actual nutrients at the lowest cost. But, unfortunately, the proportions of the nutrients in their dietaries are often very defective. Thus, in portions of India and China, rice; in Northern Italy, maize-meal; in certain districts of Germany and in some regions and seasons in Ireland, potatoes; and among the poor whites of the Southern United States maize-meal and bacon make a large part and in some cases almost the sole food of the people. These foods supply the nutrients in the cheapest forms, but all are deficient in protein. The people who live upon them are ill-nourished and suffer physically, intellectually, and morally thereby.

“On the other hand, the Scotchman finds a most economical supply of protein in oatmeal, haddock, and herring; and the rural inhabitants of New England supplement the fat of their pork with protein of beans, and the carbohydrates of potatoes, maize, and wheat flour with the protein of codfish and mackerel, and, while subsisting largely upon such frugal but rational diets, are well nourished, physically strong, and noted for their intellectual and moral force.

“As population becomes denser, the capacity of the soil to supply food for man gradually nears its limits. Fish gather materials that would otherwise be inaccessible and lost, and store them in the very forms that are most deficient in the produce of the soil. Thus, by proper

culture and use of fish, the rivers and the sea are made to fulfill their office with the land in supplying nutriment for man."

#### 17.—TURBOT AND SOLES.

In the great variety of excellent marine fish found on the coast of the United States, it has been necessary only to consider the question of the introduction of the turbot and sole, both fish of world-wide reputation, the possession of which the European epicure promptly offers as an offset to the pompano, the Spanish mackerel, the sheepshead, and our other esteemed varieties. The U. S. Fish Commission has frequently been urged to take the necessary steps to acclimate these fish in the waters of the United States; and several successive efforts have been made in that direction, some of which have failed entirely, and others resulted in the planting of a few individuals in the open sea off Boston Harbor and New York. As no care could be exercised over these fish, and there was nothing to prevent their being devoured, almost as soon as planted, by predaceous fish, no definite result could be expected from what has been done, in the lack of localities that could be completely controlled.

With the completion of the preparations at the Wood's Holl Station for the propagation of sea fishes, it has become possible to provide for permanent inclosures in the sea where the fish, while having their natural surroundings, can be watched and cared for, and from which they can be removed for the purpose of taking and fertilizing the eggs, to be subsequently hatched out.

For this purpose arrangements were initiated in the early part of the year to obtain from England a supply of these fish, and the services of a skilled attendant were bespoken. In the mean time the authorities of the National Fish Culture Association, to which the Commission had sent some highly-valued lots of eggs and young of various species of American fishes, asked that they might be permitted to make a transmission in return, and this proposition was gladly accepted.

It was found impossible to obtain any turbot; but the brill, a large flounder closely allied to the turbot, was substituted in its place. Several hundred young soles, about the size of the hand, and a number of brill were accordingly gathered and stored on the eastern coast of England, and the necessary arrangements made for their shipment per steamer Republic from Liverpool on September 1. The fish were sent to Liverpool the day before, but, being overcrowded in their tanks, most of them died in transit. The survivors being very much weakened, all the efforts of Mr. W. T. Silk, who had been deputed by the National Fish Culture Association to care for them, were unavailing, and the entire number died before being put on board. The experiment will, however, be renewed another season, as the stake is a great one, and is worthy of continued experiment until success is secured.

Contemporaneously with the efforts which were being made in our behalf by the National Fish Culture Association of England, Mr. E. G. Blackford was conducting negotiations with Mr. Thomas J. Moore, curator of the Liverpool Museum, for obtaining soles. The methods adopted by Mr. Moore for getting fish across the Atlantic proved successful, as nine out of twelve sent in October, with no special attendant, reached New York alive, thus apparently solving the question of method by which importations can be successfully made.

In the latter part of October a renewal of the efforts of Mr. W. Oldham Chambers in behalf of the National Fish Culture Association resulted disastrously, as has already been described under the head of courtesies received from foreign countries.

Notwithstanding the numerous disappointments of the present year, there is good reason to believe that in another summer enough flat-fish may be accumulated at Wood's Holl to form a nucleus for propagation. It is believed that the facilities at Wood's Holl are adapted to this work.

Referring to the recent efforts to introduce the sple, Mr. William Stowe, the president of the Gloucester Net and Twine Company, of Boston, says: "I regard it as being worth to us as a nation all the money the Government has spent on it. In England I had sole for every breakfast. It is the best tasted fish that swims."

#### 18—SPONGES FOR AUSTRALIA.

A communication was received from Dr. R. von Lindenfeld, of Sydney, Australia, dated June 1, 1885, through Professor Hyatt, of the Society of Natural History, Boston, asking the services of the U. S. Fish Commission in sending a supply of live bathing sponges for introduction into the bay of Port Jackson, and offering the sum of £25 sterling to meet the necessary expenses.

On a careful consideration of the circumstances it was thought that while the project was perhaps not impracticable, yet it would be impossible to do anything with the amount named. These sponges could only be obtained conveniently at Key West or Bermuda; and there being no steamers going direct from those points to Sydney, it would be necessary to send them to England, or else intersect a steamer at Saint Thomas or other point of contact of vessels bound from Great Britain to Australia. To make a successful experiment it would be necessary to provide special apparatus for furnishing a constant supply of pure salt water to the sponges, involving preparations which would be difficult to secure from the steamers. Indeed, we do not yet know how far it would be possible to keep the sponges alive, experiments being lacking on this head. Should the opportunity present itself some aquarium experiments will be made to see in what way this work can be best accomplished under the proper conditions.

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

## 19.—PROGRESS IN PRINTING THE QUARTO FISHERIES REPORT.

During the year 1885 considerable progress was made towards the completion of the special quarto report upon "The Food-Fishes and Fisheries of the United States," ordered printed under act of Congress in 1882.

Section I of this report, "Natural History of Useful Aquatic Animals," was published and distribution begun late in the fall of 1885. This section is bound in two volumes, one containing eight hundred and seventy-five pages of text and the other two hundred and seventy-seven plates of illustrations of all the important species. The analysis of this volume was printed in the annual report for 1883.

Section II, "The Fishing Grounds of North America," which was partly in type in 1884, was completed in 1885, with the exception of an appendix on ocean temperatures, now being prepared by Mr. Rathbun. This section numbers pages i-xviii, 1-154, with seventeen charts and a number of temperature diagrams.

The table of contents of this section is as follows :

Introduction by Richard Rathbun.

A.—The sea-fishing grounds of the Pacific coast of the United States from the Strait of Fuca to Lower California. By David S. Jordan.

B.—The fishery resources and fishing grounds of Alaska. By Tarleton H. Bean.

C.—The fishing grounds of the Great Lakes. By Ludwig Kumlien and Frederick W. True.

D.—The geological distribution of fresh-water food-fishes in the several hydrographic basins of the United States. By David S. Jordan.

Section III will be a statistical review of the fisheries and fishing districts, with a list of fishing vessels, giving for each vessel the name, rig, tonnage, number of crew, fishery engaged in, and other details. This section is not yet in type.

The geographical review of the fisheries or "coast review," with statistics, which was to have formed Section III of this report, has been transferred to the Census Office, and will be issued by the Department of the Interior as one of the volumes of the Census Report. It was all put in type in 1885 and comprises about eight hundred pages. Its contents will be as follows :

- PART
- I.—The coast of Maine and its fisheries. By R. Edward Earll.
  - II.—The fisheries of New Hampshire. By W. A. Wilcox.
  - III.—The fisheries of Massachusetts. By A. Howard Clark.
  - IV.—The fisheries of Rhode Island. By A. Howard Clark.
  - V.—The coast of Connecticut and its fisheries. By A. Howard Clark.
  - VI.—New York and its fisheries. By Fred Mather.
  - VII.—New Jersey and its fisheries. By R. Edward Earll.
  - VIII.—Pennsylvania and its fisheries. By R. Edward Earll.
  - IX.—Delaware and its fisheries. By J. W. Collins.

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PART X.—Maryland and its fisheries. By R. Edward Earll.

XI.—Virginia and its fisheries. By Marshall McDonald.

XII.—North Carolina and its fisheries. By R. Edward Earll.

XIII.—The fisheries of South Carolina and Georgia. By R. Edward Earll.

XIV.—Eastern Florida and its fisheries. By R. Edward Earll.

XV.—Fisheries of the Gulf of Mexico. By Silas Stearns.

XVI.—The fisheries of the Pacific coast. By David S. Jordan.

XVII.—The fisheries of the Great Lakes. By Frederick W. True.

APPENDIX. Historical reference to fishermen of New England. By A. Howard Clark.

Section IV. "The fishermen of the United States," by George Brown Goode and Joseph W. Collins, was put in type during 1885, and with the index numbers 178 pages, and will probably be published during the coming year. The contents of this section were as follows:

### A.—NATIONALITY AND GENERAL CHARACTERISTICS.

1. Review of the class as a whole.
2. The shore fishermen of Maine.
3. The vessel fishermen of Maine.
4. The fishermen of the Isles of Shoals.
5. The Indian fishermen of New England.
6. The British-Provincial fishermen of New England.
7. The Irish fishermen of New England.
8. The Scandinavian fishermen of New England.
9. The Portuguese fishermen of New England.
10. The negro fishermen of New England.
11. The "baymen" or fishermen of Long Island, New York.
12. The oystermen of Maryland.
13. The oyster-shuckers of Maryland.
14. The fishermen of Florida.
15. The fishermen of Mobile, Ala.
16. The fishermen of New Orleans, La.
17. The fishermen of Texas.
18. The American fishermen of California.
19. The Italian fishermen of the Pacific coast.
20. The Portuguese fishermen of the Pacific coast.
21. The Spanish fishermen of the Pacific coast.
22. The Greek fishermen of the Pacific coast.
23. The Austrian fishermen of the Pacific coast.
24. The French fishermen of the Pacific coast.
25. Southern European fishermen of the Pacific coast.
26. The Chinese fishermen of the Pacific coast.
27. Miscellaneous fishermen of the Pacific coast.
28. The Arctic whalers from San Francisco.
29. The fishermen of the Columbia River.
30. The Indian fishermen of the Pacific coast.
31. The McCloud River Indians of California.
32. The fishermen of the Great Lakes.

### B.—THE SAILOR-FISHERMEN OF NEW ENGLAND.

33. Shore education.
34. Sea education.
35. Mental and physical traits.
36. Superstitions.



37. Dialect.
38. Literary tastes.
39. Morals and religion.
40. Life ashore.
41. Life on board the vessels.
42. Public service.
43. Costume.
44. Food.
45. Diseases and longevity.
46. Financial profits.

C.—OFFICERS OF VESSELS; DISCIPLINE OF THE CREW; NAVIGATION.

47. Officers and discipline in fishing and whaling vessels.
48. Navigation.

D.—DANGERS OF THE FISHERIES.

49. Dangers to the vessels.
50. Dangers to the fishermen.
51. Relief for bereaved families.

E.—MANAGEMENT OF THE VESSELS.

52. Evolutions of the fishing schooner.
53. Amount of canvas carried.
54. Management of disabled vessels.

F.—APPENDIX.

55. Freeman's description of Cape Cod fishermen.
56. Autobiography of Capt. N. E. Atwood.

Section V is a discussion of the history and methods of the fisheries, and will be in two volumes. The first volume will discuss the capture of fish, and the second volume the capture of aquatic animals, crustaceans, sponges, &c. The greater part (or 565 pages) of Volume I was put in type in the summer and fall of 1885 and most of the illustrations were engraved. This section is made up as follows:

VOLUME I.

- PART
- I.—The halibut fisheries.
  - II.—The cod, haddock, and bake fisheries.
  - III.—The mackerel fishery.
  - IV.—The swordfish fishery.
  - V.—The menhaden fishery.
  - VI.—The herring fishery and sardine industry.
  - VII.—The shore fisheries of Southern Delaware.
  - VIII.—The Spanish-mackerel fishery.
  - IX.—The mullet fishery.
  - X.—The red-snapper fishery and the Havana market fishery of Key West, Fla.
  - XI.—The pound-net fisheries of the Atlantic States.
  - XII.—The river fisheries of the Atlantic States.
  - XIII.—The salmon fishery and canning interests of the Pacific coast.
  - XIV.—The fisheries of the Great Lakes.

## VOLUME II.

- PART XV.—The whale fishery.  
 XVI.—The blackfish and porpoise fisheries.  
 XVII.—The Pacific walrus fishery.  
 XVIII.—The seal and sea-otter industries.  
 XIX.—The turtle and terrapin fisheries.  
 XX.—The oyster, scallop, clam, mussel, and abalono fisheries.  
 XXI.—The crab, lobster, crayfish, rock lobster, shrimp, and prawn fisheries.  
 XXII.—The leech trade and the trepang fishery.  
 XXIII.—The sponge fishery and trade.

Other sections of this report on "Fishing vessels and boats," "Apparatus of the fisheries," "Preparation of products," "The river fisheries," and "Bibliography of American ichthyology," will be published as soon as practicable.

## 20.—INVESTIGATIONS OF THE FISHERIES OF THE GREAT LAKES.

In 1871, at the very inception of the Commission, an investigation of these fisheries was made by the late James W. Milner; and statistics of this industry on the Great Lakes were again gathered, for the census of 1880, by Mr. Ludwig Kumlien. The comparison of the work of Milner and Kumlien led to very grave fears that the fisheries for whitefish were about becoming exhausted. While it was true that the total number of pounds obtained in 1880 was equal to or greater than that obtained in 1871, the effect had been accomplished by the use of apparatus increased enormously in effectiveness and by the addition of steam-tugs using a far greater number of gill-nets. More ominous than anything else was the fact that the average size of the fish taken was much smaller. It was realized that the utmost efforts should be made by way of artificial propagation to avert the impending catastrophe. Accordingly the United States Commission, as well as those of Ohio and Michigan, planted many millions of whitefish fry each year from 1878 to the present time, the number planted some years equaling 50,000,000.

At the close of the fishing season last year a limited investigation of the whitefish product of Lake Erie was made by Mr. Frank N. Clark. His conclusion was as follows:

"The results are most gratifying, as it is conceded by all and shown by the reports that the aggregate catch of whitefish was considerably in excess of that of any season for several years.

"No disappointment would have been felt had there been no perceptible increase, as much planting of fry was required to offset the extensive and exhaustive fishing carried on all over the lake, on both the spawning and feeding grounds. For many years these had been literally covered with nets during the spawning season, while hundreds of gill-nets have been employed on the feeding-grounds in deeper waters. Notwithstanding this, however, we find that not only has the decrease been arrested, but that there is a tangible and satisfactory increase."

The need of restricting the fishermen manifested itself at the meeting of the fish commissioners of the lake States, held at Milwaukee August 17 and 18, 1884, where resolutions were passed instructing the commissioners to urge upon the legislatures of the various States the enactment of statutes regulating the size of mesh so as to catch mature fish only and the adoption of the close season for certain kinds of fish.

With a view of ascertaining more definitely the present condition of the fisheries and of recording any important changes that have occurred in the locality of methods of the fisheries since the census of 1880, it was decided to make a careful examination of the entire chain of lakes from the American shores and to obtain accurate statistics for comparison with those of earlier years. The investigation began late in August, under the general direction of Mr. R. E. Earll. The territory was divided into districts and assigned to different employees of the Commission who from their familiarity with the work were best suited to assist in the investigation. To Messrs. Clark and Wires was assigned the American shore of Lake Huron and the Detroit River; to Mr. Ellis, the American shore of Lake Ontario and eastern part of Lake Erie; to Mr. Bowers, western shore of Lake Erie, and to Mr. Earll, Lake Superior and both shores of Lake Michigan. The investigation began in August and was continued until November. The following plan of operations, which had been prepared by Mr. Earll, was carefully followed:

(1) Obtain a brief description of each settlement, especially of those containing post-offices, however small and scattered the population, in order that its relative importance or insignificance may be known.

(2) Fill out in detail the blank form of each fishing station, note the number of men employed, number of tugs or sail-boats employed, the kind and number of gill-nets, pound-nets, seines, fykes, or set-lines, the number of pounds of hard fish, soft fish, or other fish caught in 1885, the gross value of the seine, stating particularly the quantity of white-fish taken.

(3) Fill out a blank for each fishing settlement showing separately the seining, spearing, hand-line, net-fishing, &c.

(4) Fill out a blank at each fishing settlement estimating the amount of fish consumed by fishermen's families or by local trade.

(5) Record on the proper blanks all fishing steamers and all sailing vessels that use custom-house papers.

(6) Note the number of fishermen's boats, nets, and pounds employed the preceding year, as far as practicable, for the purpose of comparison with 1885 and for estimate in case information is not obtained for 1885.

(7) Mark on charts the exact location of each pound-trap and other stationary forms of apparatus, with the name of owner. Show the location of important fishing banks and reefs, their shape, size, name, location, depth of water, character of bottom, and history.

(8) Leave circulars with each fishery operator to be filled up and forwarded at the close of the season. Do not leave any village or locality until a satisfactory estimate has been obtained of the extent of the fishery, and the total catch, especially of whitefish and trout.

Many of the fishermen were found to be deeply interested in the work of the Commission, and they willingly furnished the desired information and rendered such other assistance as they were able. The impression of the gentlemen engaged in the investigation was that there had been a decided increase in the fisheries over those of previous years and that they now furnish employment to a larger number of men and a greater amount of capital than at any previous period in their history. If the opinions of the fishermen are to be accepted, there has been a very perceptible increase in those localities where the planting of fry has been most extensive, and in a number of other districts where the catch has been falling off from year to year further decrease seems to have been checked. The compilation of statistics and the preparation of a report will be pushed forward as rapidly as possible.

#### 21.—USE OF THE COD GILL-NETS.

The introduction of this mode of taking codfish, dating from 1880, with the exception of one season, has been a success. There has been during these years a yearly increase in the number of vessels, men, and nets employed.

This mode of fishing is one in high favor with the fishermen, as it requires less labor than any other, the catch is greater for the labor employed than by any other way, there are no bait bills, and it enables the fishermen to make harbor every night, as the grounds are always near shore. It is conceded to be a fact by the men themselves that, notwithstanding the great expense, their clear profits are larger for the time engaged than by any other method of taking codfish, or, in fact, than in any other kind of fishing.

The season of cod gill-net fishing on our coast dates from about October 1 to June 1, in the extremes. Nearly all vessels, however, close the season about May 1.

The fish are caught in water varying from 8 to 35 fathoms in depth. The greater depths are objectionable, owing to the extra labor required in handling, so that the fishermen avoid deep water. The distance from the shore varies from 200 yards to 7 miles; and it is reported that the fish are being taken in deeper water than formerly.

The number of vessels engaged in this industry last season was about forty, employing about four hundred men; the tonnage of vessels was from 15 to 70 tons, with twenty-four to forty nets per vessel.

These nets are made to hang 50 fathoms in length and 12 to 15 feet in depth, and the size of mesh now used almost entirely is 9-inch. They are floated with glass balls about 5 inches in diameter, and costing, cov-

ered, so that they can be attached to the top of the net, about 20 cents each; there are twenty to each net, or one to every  $2\frac{1}{2}$  fathoms; weighted with bricks, &c. They are treated by a process called the "Eureka process," which is believed by the American Net and Twine Company to preserve the net much better than any other they have ever tried or known of.

During the season it has been found necessary to employ two sets of nets, particularly as during the early part of the season there is a run of pollock, which are generally large, and being much more powerful fish than cod, are very destructive to the gear.

The expense per man for the entire outfit is about \$90; one-half of this is perishable and the other half, including buoys, lines, anchors, hangings, balls, and boats, stands the "wear and tear" for several seasons. Nets with floats all rigged for fishing cost about \$18 each.

The catch for the season of 1885-'86 was not far from 15,000,000 pounds of codfish and pollock, about one-quarter being the latter. The fish are taken in Massachusetts and Ipswich Bays in the shoal water, and the industry, I think, may be considered an established one, and I know no reason why it should not continue to increase from year to year.

It is a matter of considerable speculation whether this mode of capturing codfish might not be successfully prosecuted in the bank fishery. Several imperfect trials have been made without success. Ivers W. Adams, president of the American Net and Twine Company, who has furnished the above facts, says: "I have no reason to doubt, with nets properly rigged and hung, that they would be successful, and I should be pleased to manufacture a gang of these nets for the Commission, with special reference to their trial in the bank fishery. We have always made a speciality of this industry, and last year we supplied, without doubt, 90 per cent of the nets fished to the fleet."

## 22.—THE MACKEREL FISHERIES OF 1885.

The following summary of the year's mackerel fishery has been furnished by Mr. W. A. Wilcox:

The mackerel season off the United States coast began by the taking of two fares, aggregating 325 barrels, caught on March 26 and 27, 30 miles south of Cape Henry, by the schooners Nellie N. Rowe and Emma W. Brown. Most of the fleet followed the fish from that time until November 14, working off the United States coast as far east as Mount Desert, and returning taking the last fares off Cape Cod in November. The catch off the United States coast by American vessels aggregated 378,515 barrels, of which 80,788 barrels were sold fresh. In size and quality the fish were an improvement over the catch of 1884, packing mostly No. 2's, with a smaller portion No. 1's and 3's. The average price for inspected mackerel was \$4.50 to \$5.50 for No. 3's, \$6 to \$7 for 2's, extra 2's \$7.50 to \$9, and \$16 to \$18 for No. 1's. Extra 1's sold from \$20 to \$32. Some very large and fat fish were taken off Block Island,

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bringing the extra prices named. Mackerel were taken in the weirs at Truro, Mass., as late as November 19.)

The few vessels that fished in the Gulf of Saint Lawrence at times found mackerel very scarce, at times very abundant; but they were small and of poor quality. With the hopes of finding larger and better fish soon, the vessels in many cases forwarded their catch by rail or steamer to Boston or Gloucester, the same selling for \$2.12½ to \$3.50 per barrel, frequently not bringing enough to pay the cost of barrels, salt, freight, insurance, and commission, not mentioning the time, labor, and expense of the voyage. The crews fishing on shares in many cases received nothing, and the vessels' expenses exceeded their gross receipts. The catch in the Gulf of Saint Lawrence by 40 vessels, all from the United States that took any fish in those waters, aggregated 26,633 barrels, of which 6,564 barrels were taken within 3 miles of the provincial shore. These fish were mostly No. 3's with a small proportion of No. 2's. On November 21 schooners Spencer F. Baird, William E. McDonald, and William H. Jordan arrived at Gloucester from a six weeks' cruise in the Gulf of Saint Lawrence and off the Nova Scotia shore, none of these vessels having caught a single mackerel during the entire trip.

Vessels from Gloucester, Mass., are the only ones that entered provincial ports for the purpose of obtaining barrels and supplies. These purchased 9,572 empty fish-barrels, valued at \$7,425.95, and paid in addition \$9,759.05 for provisions and \$331.26 as harbor dues.

During the year 3 vessels, 22 boats, and 7 seines were lost and 4 fishermen were drowned.

*American mackerel catch for the season of 1885.*

[Reported to the U. S. Fish Commission by W. A. Wilcox, assistant.]

Port.	No. of vessels.	Tonnage.	Value of vessels.	Value of outfit.	Number of crew.	Total number of trips.	Inspected, caught off United States coast.	Sold fresh, caught off United States coast.	Total caught off United States coast.	Caught in Gulf of Saint Lawrence.	Taken within 3 miles of provincial shore.
Grand total . . . .	356	27, 035. 07	\$1, 693, 406	*\$1, 294, 225	5, 425	1, 821	Bbls. 297, 727	Bbls. 80, 788	Bbls. 378, 515	Bbls. 20, 639	Bbls. 0, 504
<i>Maine.</i>											
Biddeford . . . . .	1	52. 51	5, 000	1, 500	14	5	255	200	455		
Boothbay . . . . .	12	865. 34	45, 200	13, 050	174	53	7, 481	3, 965	11, 446		
Bristol . . . . .	1	21. 08	000	250	14	3	190		190		
Deer Isle . . . . .	3	205. 00	0, 500	2, 700	40	7	1, 700		1, 700		
Eastport . . . . .	1	97. 34	10, 000	2, 000	18	0	625	900	1, 525		
Harpswell . . . . .	1	41. 67	3, 000	1, 200	12	4	325	350	675		
Camden . . . . .	2	108. 07	3, 000	3, 000	28	8	1, 050		1, 050		
Cranberry Isles . . . . .	3	145. 47	8, 000	3, 800	31	14	1, 085	100	1, 185		
Mathews Island . . . . .	1	30. 83	1, 500	1, 400	33	3	595		595		
New Harbor . . . . .	1	41. 58	1, 200	2, 500	32	2	198		198		
North Haven . . . . .	10	1, 039. 19	60, 500	24, 000	240	77	10, 380	2, 400	18, 780		
Port Clyde . . . . .	1	41. 04	2, 000	800	12	3	380		380		
Portland . . . . .	55	4, 459. 00	335, 800	75, 030	859	280	47, 230	12, 640	59, 870	580	880

\* Including \$324,360 for salt and barrels and \$428,400 for provisions and running-gear not shown separately by ports. The amount shown in the table is for seines, pockets, and boats.

American mackerel catch for the season of 1885—Continued.

Port.	No. of vessels.	Tonnage.	Value of vessels.	Value of outfit.	Number of crew.	Total number of trips.	Inspected, caught off United States coast.		Total caught off United States coast.	Caught in Gulf of Saint Lawrence.	Taken within 3 miles of provincial shore.
							Bbls.	Bbls.			
<b>Maine—Continued.</b>											
Rockland .....	1	88.11	\$0,000	\$1,700	14	5	996	.....	996	.....	.....
Swan's Island .....	7	497.44	31,200	11,800	112	34	7,404	1,400	8,804	.....	.....
Southport .....	10	649.73	41,500	11,500	158	41	7,608	2,100	9,708	.....	.....
Vinal Haven .....	2	130.81	10,500	2,850	30	8	1,650	.....	1,650	.....	.....
<b>Total .....</b>	<b>118</b>	<b>8,720.85</b>	<b>577,000</b>	<b>150,180</b>	<b>1,820</b>	<b>559</b>	<b>95,861</b>	<b>24,055</b>	<b>110,916</b>	<b>580</b>	<b>380</b>
<b>Portsmouth, N. H. ....</b>											
	1	85.19	9,000	1,800	17	6	610	300	919	.....	.....
<b>Massachusetts.</b>											
Barnstable .....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Boston .....	1	84.49	6,000	1,500	16	7	1,800	.....	1,800	.....	.....
Dennis .....	18	1,350.11	90,000	24,100	257	80	12,412	3,040	15,452	941	.....
Chatham .....	4	300.83	30,000	4,000	67	30	6,087	1,600	7,687	.....	.....
Cohasset .....	4	289.50	13,400	2,050	58	40	3,851	1,350	5,201	.....	.....
Gloucester .....	3	211.75	10,500	3,000	47	13	2,169	.....	2,169	.....	.....
Harwich .....	140	11,168.84	713,100	248,335	2,152	775	122,694	40,143	168,837	24,379	5,984
Newburyport .....	0	454.03	23,500	0,500	97	46	6,541	450	6,991	.....	.....
Plymouth .....	1	42.60	3,000	500	14	6	72	600	672	.....	.....
Provincetown .....	2	198.90	8,000	1,800	31	10	2,232	.....	2,232	.....	.....
Wellfleet .....	15	1,117.33	46,800	18,000	227	75	13,760	2,000	15,760	733	200
<b>Total .....</b>	<b>30</b>	<b>2,860.10</b>	<b>158,300</b>	<b>61,900</b>	<b>572</b>	<b>150</b>	<b>20,412</b>	.....	<b>20,412</b>	.....	.....
<b>Total .....</b>	<b>230</b>	<b>18,189.75</b>	<b>1,084,406</b>	<b>375,585</b>	<b>3,538</b>	<b>1,241</b>	<b>108,036</b>	<b>55,183</b>	<b>253,219</b>	<b>26,053</b>	<b>6,184</b>
New London, Conn. ....	1	74.55	4,000	2,000	15	0	1,123	.....	1,123	.....	.....
New York, N. Y. ....	1	82.01	7,000	2,100	17	5	1,257	1,000	2,257	.....	.....
Philadelphia, Pa. ....	1	83.32	12,000	800	18	4	831	250	1,081	.....	.....

23.—INVESTIGATION OF THE RED-SNAPPER FISHERIES.\*

During the early months of the year the steamer Albatross was engaged in a series of cruises in the Gulf of Mexico. A part of the valuable work carried on at this time was an investigation of the fisheries for red snappers off the west coast of Florida. Two trips were made from Pensacola, one in February and the other in March, to the fishing-grounds which were known, and search was made for new ones. This was the first effort made under the auspices of the Government to examine the offshore fishing-grounds of the Gulf of Mexico, and its success and that of others bid fair to add materially to the resources of the country.

Their development must be of considerable consequence to our Gulf coast, and if methods should be applied by which the products of these fisheries could get into the general markets of the country our food supply might be materially augmented.

\* A valuable discussion of this subject may be found in an article by Capt. J. W. Collins in the appendix to this Report, p. 217.

The red snapper (*Lutjanus vivanus* Cuv. & Val. [or *Lutjanus blackfordi* Goode & Bean]) has long been locally known as a favorite food-fish, but the fishery for it has been developed within recent years when it has become known to the markets of the North and West. It is a fish that will keep for an unusually long time in ice. Thus packed in barrels or boxes it may be sent all over the country, being found in the markets of Boston, Chicago, and Denver, where, because of its bright crimson color, it is the most conspicuous fish seen. The favorite fishing-grounds for the red snapper are in the vicinity of Cape San Blas off the west coast of Florida, but specimens have been taken as far north as off the coast of New Jersey and even beyond. The Florida reefs, however, and rocky spots on the bottom at a depth of from 10 to 40 fathoms seem to be their favorite resorts, being gregarious in habit and strictly carnivorous in their food.

In the beginning of the red-snapper fishery the inshore grounds were most resorted to, but at present the most important grounds are those lying offshore, where the snapper can be found most abundant in winter, when the fishery is at its height. The headquarters of this industry is at Pensacola, which is nearer to the grounds than any other important port, and which is the most available market for the receipt and distribution of the fish.

The character of the grounds, in respect to the abundance of fish to be found upon them, seems to be changing in a very marked manner. This change, which has been most noticeable during very recent years, is still going on, and localities formerly remarkable for the abundance of fish on them only a year or so ago are now of comparatively little importance. This is shown by the fact that vessels are continually obliged to extend their cruises farther off in order to meet with success; and it is feared that this decrease in the abundance of the fish may continue until the fishery will be no longer profitable. There are several reasons why the abundance of red snappers may be more easily reduced than can be the case with the majority of food-fishes, inasmuch as these snappers are local in their habits, occupying a region of comparatively small proportions and being found only in small areas or banks within this region, and as they are taken at all seasons of the year, though preferably in winter.

Much of the work is done by fishermen from New England, some of whom are engaged off the coast of Florida during the winter, and fish off the New England coasts in summer. The vessels used in this fishery are naturally, then, for the most part, of Northern build, though it should be stated that there are vessels and boats of nearly all styles and rigs, just as the fishermen are of all classes and climes.

The fishing for red snappers is done almost exclusively with hand-lines, which are rigged in a very primitive manner, as the snapper is a greedy biter, from which fact it gets its name, and the lines are exposed to frequent loss. The bait used is taken from a wide range of smaller



fish, such as lady-fish, skipjacks, porgies, &c. A vessel engaged in this fishery usually carries from 300 to 400 pounds of salt bait on each trip. Other fish when caught may be used as bait, and this, when fresh, has the advantage of being tougher than the salt bait, and not so easily torn from the hooks. Much care must be exercised in searching for the small and closely circumscribed spots on which the snappers are found; and, even when found, the fish, which are usually so ready to take the bait, cannot always be caught.

Some vessels put the whole of their catch in ice and thus carry them to market; others carry the fish in the wells of the vessels, where much care must be taken to prevent them from dying of suffocation. In either case, when a fare is obtained it is necessary to reach the market as soon as possible. From Pensacola all the fish shipped go by rail, except those sent to New York, which are generally carried by the Savannah Steamship Company's line.

During October, November, and December the best catch of the year is made, while from the middle of March to the middle of June comparatively little is done, so that the vessels generally haul up for two or three months in summer. The fish range in weight from 2 to 35 pounds, averaging 7 pounds. The average price paid by the Pensacola dealers for the fresh fish is about 3 cents per pound, while the total amount of red snappers taken during 1885 was about 2,000,000 pounds.

As those who have the best opportunities for knowing claim that the red snappers are rapidly becoming scarcer on the grounds where they are now taken, it seems eminently desirable that some means should be adopted for preventing this depletion. If the abundance of this fish should be exhausted, a promising industry would be broken up, and the country at large would be deprived of one of the finest of our edible fishes. This may be prevented by two methods: First, the application of artificial propagation to the red snapper; and, second, the discovery of new fishing-grounds that may be worked while the old ones are recuperating. As to the artificial propagation of this fish, it must be said that at present so little is known of its breeding habits that nothing can now be done. It is a matter of congratulation that the recent researches of the Albatross have demonstrated the important fact that there is a large area of ground yet unworked off Tampa and south of it where the snapper is seemingly more abundant than where it has formerly been sought. This may give relief to the old grounds before they are too much exhausted, and may lead to further investigation and discovery.

#### 24.—THE BLACK COD OF THE PACIFIC.

The black cod (*Anoplopoma fimbria* Pallas) of the North Pacific Ocean is not a true cod (*Gadus morrhua* Linn.) in its family relation, but in its appearance somewhat nearly resembles the pollock (*Pollachius cornarius* Linn.), having a color on the back which has obtained for both itself and the pollock in some regions the name of "coal-fish." Gener-

ically the black cod is a member of the *Chiridae*, or rock-trout, family of the Pacific, which has, so far as is known, no species in the Atlantic.

As in order to obtain the common codfish (*G. morrhua*) the fish-dealers of the Pacific coast are obliged to send large vessels on trips of 3,000 miles or more to the Shumagin Islands, Behring Sea, or the Sea of Okhotsk, the occurrence of the black cod, which is found in abundance in Puget Sound, Fuca Strait, and from Cape Flattery up along the coast to Alaska, may be of great commercial significance. Black cod are not common in the markets of San Francisco, where they are small in size, weighing about 3 pounds, and are little esteemed; but farther northward they are better and larger. The fish are found of larger size and in greater numbers in the deep waters, at a distance of a few miles from the coast, being especially abundant, so far as is yet investigated, off the west coast of the Queen Charlotte Islands.

Most of the fishing has thus far been in the hands of the Indians, whose appliances are necessarily rude, though evidencing a considerable degree of skill in their adaptation to circumstances.

The problem is to catch these fish on a bottom that is more or less rocky and studded with coral, in about 100 fathoms or more of water, with a current of 4 miles an hour running in many places most of the time. This cannot be done very well with gill-nets, unless possibly they may be used as drift-nets, while the hooks of trawl-lines are apt to catch on the uneven bottom and be lost.

The best method of curing and preparing the fish for market will probably be found only after some experimenting. This cod, though fat, does not easily rust, and they may be kept in pickle, like mackerel, or preserved in various ways. Already they have been dry-salted and sent across the continent, arriving in Washington and Boston in good condition. They have been cooked in different ways and eaten by several experts, and various opinions have been expressed as to their edible qualities, all being more or less favorable. They are somewhat different in taste from any Atlantic fish; but they have a firm flesh with a good deal of fat, and are characterized by an oily savor, which some call a little "strong."

The way to treat them in order to get their true flavor is said to be to soak them for at least twenty-four hours, changing the water frequently in order to freshen them thoroughly (this is, of course, when they have been well salted), and then simply to boil them, and serve with plain boiled potatoes. When cooked in this way, they are called fat and rich, with the flavor of the best mackerel. Made into fish-cakes, the strong taste, which sometimes is found, disappears; and when broiled and eaten cold they are much liked. The black cod has been thought to resemble a bluefish or a quinnat salmon a little in its oily taste. Some have declared that when boiled the black cod tastes much like halibut's fin; others, that it closely resembles the corned Newfoundland turbot; and, as is well known, halibut's fins and turbot are con-

sidered great delicacies by those who are fond of fat or oily fish. It makes a good salt fish, though scarcely equal to our regular codfish, which it is not at all likely to displace in the Eastern markets.

When smoked it seems to be a success, and competent judges have declared it equal to the best smoked Greenland halibut. Prepared in this way, it bids fair to become a valuable article of commerce in all parts of the country, if its catch, preparation, and distribution are not attended with too great expense.

#### 25.—THE FISHERIES OF THE PACIFIC COAST.

Mr. Charles H. Townsend was sent to Alaska and the Pacific coast during the present year to study the whale and other fisheries. A preliminary report of his work, furnished by himself, is as follows:

I was in Alaska, at the Pribylov Islands, in June, 1885, engaged in zoological work, when the U. S. revenue-cutter Thomas Corwin called there on her way to the Arctic. An opportunity offering to accompany as naturalist an exploring party to be sent up the Kowak River, I went on board, and after several days' uneventful voyaging, during which we called at Saint Michael's, Golofnin Bay, and Port Clarence, the Corwin entered Behring Strait on July 1. Here we encountered much loose drift-ice, which impeded our progress into Kotzebue Sound, where we arrived at 11 o'clock on the night of July 2, the midnight sun still shining brightly, as might be expected from the high latitude and the season of year. The steam-launch was put overboard, and our party, consisting of Lieutenant Cantwell, two seamen, and myself, and several Eskimos, started up Hotham Inlet to the mouth of the Kowak. This river flows into the inlet through a delta about 40 miles wide, the islands of which bear a thick growth of low pines, the first I had seen in Alaska. It is probable that the forests approach nearer the coast here than at any other point in Northern Alaska.

In about eight days, by continuous traveling, we reached the head of steam-launch navigation, at a distance of nearly 350 miles from the sea, finding plenty of pine fuel all the way for our little steamer. Here, with the assistance of two seamen, I set up my laboratory on board the launch, which was supplied with a good canvas cover, and began collecting, Lieutenant Cantwell and the natives going on to the source of the river with the canoes. During the three weeks that I remained at this camp, a remote spot in the interior of Alaska, and considerably north of the arctic circle, I gathered a goodly collection of fishes, birds, mammals, and plants, and filled my note-book with memoranda on the natives and the physical aspects of the country.

Lieutenant Cantwell found the source of the Kowak in a large lake among the mountains nearly 450 miles from the sea, a lake swarming with the largest of trout (*Salvelinus namaycush*). Photographs were taken at many places along the river, as well as observations for lati-

tude and longitude. The Kowak flows through a well-wooded country, the forests frequently being separated by long stretches of open tundra land. We saw a few reindeer, and had evidence of the presence of many kinds of fur-bearing animals. Birds, 53 species of which I found along the river, were numerous, and we fared well on the abundant fish and wild fowl. Nearly every day we passed camps of natives engaged in fishing, by whom we were always kindly received. The Kowak teems with fish, of which I secured 18 species, including a few salt-water forms from Kotzebue Sound.

We joined the Corwin at Kotzebue Sound on September 1, having passed Lieutenant Stoney's party late in August as we descended the river. Another party sent out from the Corwin, in charge of Engineer McLenegan, had in the mean time explored the Noatak River, which also flows into Kotzebue Sound.

At Hall Island, in Behring Sea, on our return trip, I killed an immense polar bear, which I succeeded in preserving in good condition for the national collection, with the help of the sailors Captain Healy kindly sent to me.

On September 10 I disembarked at Saint Paul Island, where I spent a month collecting and studying the fur seals. From there I went to Oonalaska, where I spent two weeks with the birds and the fishes, and returned to San Francisco by the Alaska Commercial Company's steamer Dora, arriving on November 8.

My entire Alaskan collections are as follows :

Mammals, 36 specimens (19 of which were fur seals), the rest mostly small animals, representing 12 species; birds, 268 specimens, embracing 80 species; fishes, a collection representing 18 species. One bird from Otter Island (*Tringa damascensis*) is new to the fauna of North America.

My report on the natural history and ethnology of Northern Alaska is now in the hands of the Public Printer.

From San Francisco I proceeded to Humboldt Bay, Northern California, where I remained until December 17, gathering statistics relating to the fishes of that part of the coast, and where I also obtained 150 birds and 11 mammals. I then spent a month visiting the whaling stations along the southern coast of California and making inquiries respecting the present condition of the gray-whale fishery. Owing to stormy weather I was unable to obtain a skeleton of this whale. My studies of this once valuable and now somewhat rare whale indicate that the species is gradually re-establishing itself, now that it is undisturbed in its breeding resorts in the lagoons of Lower California.

## 26.—TREATY RELATIONS WITH GREAT BRITAIN.

As is well known, the provisions of the treaty of Washington relative to the situation of Americans in the fisheries of Canada terminated on

July 1, the United States having given the requisite notice to bring about such result. Although an understanding was reached between the Governments of Great Britain and the United States that fishing privileges would continue until January 1, 1886, substantially as they had heretofore existed, the necessity of obtaining data on which to base subsequent negotiations was clearly seen. In order that this Commission might co-operate in the fullest way with the other branches of the Government, it was determined to enter upon the most practicable arrangements for collecting information. I accordingly, on the 10th of December, addressed the following letter to the honorable Secretary of the Treasury, which resulted in the desired instructions being given to the customs officers and in the cordial co-operation of the Chief of the Bureau of Statistics of the Treasury Department in the work. It is yet too early to speak concerning the results of this undertaking.

U. S. COMMISSION OF FISH AND FISHERIES,  
Washington, D. C., December 10, 1885.

SIR: The necessity of shaping and negotiating a new fishery treaty with Great Britain affecting colonial waters in North America, and the frequent petitions to Congress for general and special legislation affecting the localities, seasons, and apparatus to be used in the capture of different species, render it especially desirable to have at hand, available for reference, full and accurate information regarding our fishery interests.

A very large percentage of the fish are taken by means of vessels licensed to engage in the fisheries by the Treasury Department. The regulations of said Department require that the papers permitting the vessel to be used in fishing be renewed at least once a year, and that the owner or master of said vessel, or both, appear before the proper officials of the Department to make the necessary signatures.

The owner and master of each fishing vessel are thoroughly informed regarding the movements of the vessel and the amount of fish taken during the last period of enrollment or license. I have, therefore, caused the inclosed list of questions calling for general and statistical information to be prepared for your consideration, and if it meets with your approbation would respectfully request that you will cause the same to be printed and distributed among the various customs officers along the coast and in the region bordering on the Great Lakes, and that you will instruct the officials of your Department to fill out the blank from information obtained from the owner or master whenever they shall present themselves at the custom-house to obtain or renew the necessary papers for their vessel. I have further to request that such blanks as may have been filled out, or copies of the same, be forwarded to me for compilation on the first day of the month following the renewal of the vessel's papers.

By such an arrangement it is possible to obtain general and statistical information of the greatest value to the Government for purposes of legislation and record. The compilations from the blanks will, if so desired, be sent to the Treasury Department for publication.

I have the honor to be, yours very respectfully,

SPENCER F. BAIRD,  
*Commissioner of Fish and Fisheries.*

The Hon. SECRETARY OF THE TREASURY,  
*Washington, D. C.*

A circular with numerous questions was prepared and sent out to fishermen and owners interested in cod, halibut, and other ground fisheries. A copy of this circular will be found in the supplement, page CXI.

### C.—THE INCREASE OF FOOD-FISHES.

#### 27.—BY PROTECTIVE MEASURES.

In addition to the reasons mentioned in previous reports for enacting protective measures, it has been ascertained that a very slight pollution of river water by the refuse from gas factories is fatal to shad. In response to a request from the Commissioners of the District of Columbia, in May of the present year, I directed Colonel McDonald to investigate this subject. The following is extracted from his report:

I respectfully transmit herewith a report of a series of experiments made in obedience to your instructions, with the object of determining the extent of the injurious or deleterious influences exerted upon young shad confined in water containing different proportions of the waste products from the ammonia works in West Washington.

The sample experimented with was furnished by the Board of Health, and was obtained from the above-named works. A portion of the original solution has been retained for reference. The result of the experiments shows that this waste product exerts a distinctly deleterious influence when present in the water to the amount of one-fourth of 1 per cent or in the proportion of 1 gallon to 400 gallons of Potomac River water. No experiments were made with solutions of less strength than one-fourth of 1 per cent. If we consider only the direct effect on young shad which have not yet begun to feed, it is probable that the area of injurious pollution in the case of the Potomac River does not extend very far from the point at which the waste products are discharged into the river.

Before coming to any definite conclusion, however, we must take into consideration the fact that the very young shad, which have not yet begun feeding, are much less sensitive to injurious influences in the water in which they are than the same fish after their sacs have been absorbed and they have begun feeding. We must further consider that the minute food upon which the young shad feed is much more sensitive to injurious influences (especially those exerted by the presence of coal-tar products) than are the young fish which feed upon them.

Other investigations point to the same conclusions, as shown by the following quotation from the Popular Science Monthly:

Messrs. C. Weigett, O. Sacre, and L. Schwab have investigated the effects on fisheries and fish-culture of sewage and industrial waste waters, and find them very

damaging. Chloride of lime, 0.04 to 0.005 per cent chlorine, exerted an immediately deadly action upon tench, while trout and salmon perished in the presence of 0.0008 per cent of chlorine. One per cent of hydrochloric acid kills tench and trout. Iron and alum act as specific poisons upon fishes. Solution of caustic lime has an exceedingly violent effect upon them. Sodium sulphide, 0.1 per cent, was endured by tench for 30 minutes.

## 28.—BY THE USE OF FISHWAYS.

*Fishway over the Great Falls.*—Reference has been made to this work in previous reports. Since then a site has been selected for the construction of a suitable fishway which it is hoped will enable shad, striped bass, and other food-fishes to ascend to the upper portion of the Potomac.

A plan of fishway, suggested by Colonel McDonald, who prepared the necessary working drawings for the purpose, was adopted, and recommended to the Secretary of War for such further action as he might think proper.

A contract having been given out by direction of the Secretary of War for constructing the fishway, work was pushed forward during the summer of 1885. The conditions of the contract required the entire work to be completed on October 31 of the present year. Five sections were at that date in process of construction, and high water occurring at about that time found none of the six sections completed, and put an end to the work for the season.

The lowest or sixth section was most advanced toward completion, needing only the setting of the line of coping provided for in the plans and specifications to insure the permanence and durability of the construction. It suffered little or no injury from the floods and ice of the winter, and needs only to be completed as planned to render this part of the construction permanent.

The work remaining to be done at the end of the year is as follows:

- (1) The erection of a weir dam, about 40 feet long and 5 feet high, from the abutment of the fishway to the opposite shore, the object of this being to regulate and control the supply of water to the fishway, and, at the same time, to provide for discharge of the surplus water.
- (2) To clear out the channel below the weir dam, so that the water flowing over the dam may be discharged into the river below by the side of the fishway, instead of over the lower end, as is now the case.
- (3) The placing and securing of the 12-inch coping to cover the rubble masonry walls forming the sides of the fishway.
- (4) The removal of the loose rock piles up at the lower end of the fishway and excluding fish from access to it.

The matter will be brought to the attention of the Secretary of War in the spring of 1886 with the request that at least section 6 be completed at once. An additional appropriation may be required for completing the other sections.

## 29.—SOME OPINIONS OF THE IMPORTANCE OF ARTIFICIAL PROPAGATION.

Sir Lyon Playfair made a very careful examination of the Wood's Holl Station and other appliances of the Commission, and on his return to England endeavored to stimulate endeavor in Great Britain by the following allusions to the United States:

"In regard to the special subject of carp, much progress has been made in the United States by the introduction of the two German varieties. It is curious that they should have done so before the mother country, for the remains of old fish ponds are spread over England, and are almost always near the old monasteries. Tens of thousands of old carp ponds once existed in England, but as the carp were no longer cultivated they reverted to their wild state and became valueless. In China and Germany the culture of carp is still an important industry. The United States, in introducing the culture, wisely selected the German species. In 1882 the carp bred in the Commission ponds at Washington were distributed in lots of twenty to ten thousand applicants in every State and Territory. The average distance to which they were sent was 900 miles, and the total mileage of shipments was 9,000,000 miles; while the actual distance traversed by the transportation railway cars was 34,000 miles. Already German carp have been introduced into thirty thousand separate waters.

"But I do not wish to limit my letter to carp by any means. Aquaculture has become an important affair of the State among our transatlantic brethren. The separate States prosecute it, and in 1882 spent £24,000 in its promotion. The National Government spent nearly £30,000 on the same object. The scale on which this is done may be indicated by the fact that the Government at Washington provided the Fish Commission with two steamers, commanded by officers of the Navy, and specially designed for scientific research and for fish propagation. The Albatross, of 385.82 tons, is a model of what a ship should be for the first purpose; the Fish Hawk, of 205.71 tons, is not good in heavy seas, but is well fitted for the latter purpose. There are seventeen hatching stations, of which the head is at Wood's Holl, in Massachusetts. Having paid a short visit to Professor Baird there this year, I am tempted to enlarge upon it; but I will only say that there is an excellent house for the staff, containing thirty beds, laboratories for research, and hatching ponds for 2,000,000 young cod. Much of the work is done by volunteer agency. The various universities send their naturalists, and the Smithsonian Institution devotes money for special researches and publications.

"There is an essential difference between the mode of proceeding of the Government of the United States and that of our own country in relation to fisheries. We have had commissions without end, on some of which I have served. Vast bodies of contradictory evidence have been obtained from fishermen, who, I agree with Huxley, know less



about fish than the community. Our commissions have led to little useful result. The American commissioners act in a different way. They put questions directly to nature and not to fishermen. They pursue scientific methods, and not those of "rule of thumb." They make scientific investigations into the habits, food, and geographical distribution of fishes, and into the temperature of the seas and rivers in which they live or spawn. Practical aims and experiments are always kept in view. As an experiment, they tried to introduce shad on the Pacific coast and succeeded; they tried to introduce California salmon to the Atlantic slope and failed. As an instance of a practical aim, they have restocked the Sacramento and its tributaries so effectually that the annual increase each year, for the last few years, has been 5,000,000 pounds.

"The object of my letter is to show that, while the private propagator may cultivate young fish by thousands, aquaculture can only be undertaken by a government, for its statistical results must be counted up by hundreds of millions. In the United States all the departments of the Government cordially co-operate in fish-culture; the railways assist, and provincial bodies are active. In Scotland we have a fishery commission, willing and able to make experiments, but the Admiralty cannot find a vessel to make dredging experiments, and the Treasury cannot find £1,000 to carry out important researches only half complete. Biological stations in England and Scotland are being formed slowly on account of deficient public support."

A very interesting series of articles published in the American Field by Mr. A. Booth, a well-known fish-dealer of San Francisco and Chicago, commencing with the number for November 7, 1885, contains some very important suggestions. He calls attention to the fact of the very great decrease that has taken place in the fishery industry, and quotes the statement of an old and experienced fisherman of the lakes, as follows:

"Fifteen years ago a sail-boat, with a crew of four men, used to run from eight to twelve gill-nets, and catch 2,000 or 3,000 pounds of fish at a haul. Now it takes a gang of sixty to eighty nets to catch as many pounds, and it takes a steam-tug and seven men to tend the nets. We may catch more fish now, altogether, but we don't make as much money as we did a while ago."

He further remarks that originally "whitefish in almost any quantity could be taken at almost any point along the shores of the lakes and their connections, even by the use of seines, and the pound-nets rarely needed to be more than 20 feet in depth. Now the fish have become so scarce that it is no unusual thing to run out as much as 40 miles to their fishing-grounds, and pound-nets are used 40, 60, or even 100 feet in depth."

An examination of the books of a very successful fisherman of Milwaukee shows that where formerly his catch averaged 1,000, 2,000, and 3,000 pounds, now it scarcely amounts to as many hundreds.

LXXVI REPORT OF COMMISSIONER OF FISH AND FISHERIES.

In an article on the improvement of fisheries, by Mr. A. Booth, he states in reference to the utility of artificial propagation that, about eleven years before (in 1871), he started a salmon cannery on the Sacramento River, in California, but was forced to abandon it for lack of fish. About the same time the U. S. Government started a salmon hatchery on the McCloud River, a tributary to the Sacramento. In about three years he went back to his cannery, and year before last (1883) there were eleven canneries on that stream, and each had all the fish it could handle.

He thinks, therefore, that the depletion of the finer fish in the Great Lakes as well as in the river, whether salmon, whitefish or other species, can, without any question, be remedied by artificial propagation.

So impressed was Prof. J. Cossar Ewart, of Edinburgh, with what he saw of the American methods in his visit in 1884, that, at his suggestion, the Scotch Fishery Board cabled to send, at their expense, a fish-culturist competent to conduct operations in connection with the sea-fisheries, and to assist them in inaugurating methods for the multiplication and propagation of various species.

The Chilean Government, similarly impressed with the importance of preserving its fisheries, placed the matter in the hands of an engineer and entered into negotiations with this Commission as has already been described under the head of "Courtesies to Foreign Countries."

30.—BY THE DISTRIBUTION OF FISH AND EGGS.

Since the fish transportation cars were constructed, the method of the distribution of fish and eggs has been almost entirely changed; namely, from service by means of messengers using the baggage-cars of passenger trains, to the employment of cars built or fitted by the Commission expressly for the purpose. A great economy of service has been the result; and where a shipment of ten thousand was formerly possible, millions can now be sent. This work has been under the direction of Colonel McDonald.

The total distribution of fish to public waters in the United States during ten years of activity, viz, from 1872 to 1882, has been tabulated under Colonel McDonald's direction, and the table will be found on pages CX and CXI of this report. It shows the following totals:

Fish.	Number.	Fish.	Number.
Shad.....	200, 046, 350	Brook trout ..	88, 200
Whitefish.....	77, 072, 000	Salmon trout.....	40, 000
California salmon.....	33, 172, 734	Cod.....	25, 000
Atlaptic salmon.....	12, 519, 887	Rangeley trout.....	12, 500
Fresh-water herring.....	9, 833, 000	Schoodic salmon (hybrid).....	10, 000
Landlocked salmon.....	6, 404, 961	Rhine salmon.....	4, 500
Rockfish or striped bass.....	400, 000	Moranke.....	409
Spanish mackerel.....	270, 000		
White perch.....	180, 000	Total.....	841, 096, 971
California trout.....	110, 830		

## 31.—SPECIES OF FISH, ETC., CULTIVATED AND DISTRIBUTED IN 1885.

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 codfish. 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 being greatly extended.

The following is a list of the species included:

- a. The Codfish (*Gadus morrhua*).
- b. The White Perch (*Roccus americanus*).
- 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 California, Rainbow, or Mountain Trout (*Salmo irideus*).
- i. The Atlantic or Penobscot Salmon (*Salmo salar*).
- j. The Schoodic or Landlocked Salmon (*Salmo salar* subsp. *sebago*).
- k. The Brown or European Trout (*Salmo fario*).
- l. The Loch Leven Trout (*Salmo levenensis*).
- m. The Quinnet or California Salmon (*Oncorhynchus chouicha*).
- n. The Shad (*Clupea sapidissima*).
- o. The River Herring (*Clupea astivalis*).
- p. The Smelt (*Osmerus mordax*).
- q. The Tomcod (*Microgadus tomcodus*).
- r. The Carp (*Cyprinus carpio*).
- s. The Goldfish (*Carassius auratus*).
- t. The Golden Ide or Orf (*Leuciscus idus*).
- u. The Tench (*Tinca vulgaris*).
- v. The Catfish (*Amiurus nebulosus*).
- w. The Little Round Clam (*Tapes staminea*).
- x. The Oyster (*Ostrea virginica*).
- y. The American Lobster (*Homarus americanus*).

In addition to the species mentioned in the foregoing list, the red-eye perch (*Ambloplites rupestris*) and black bass (*Micropterus dolomieu*) have received favorable consideration and may perhaps be added to the list of species cultivated at an early date. A small lot of each was collected the present year for the special purpose of meeting a request from the Marquis of Exeter.

The black bass, although frequently called for, cannot be recommended to farmers generally, or for use in limited waters, on account of the carnivorous nature of the species, the necessity of keeping them apart from other fishes, and the expense of providing them with suitable food. They are, however, frequently used to advantage for stocking rivers and large bodies of water.

## LXXVIII REPORT OF COMMISSIONER OF FISH AND FISHERIES.

The Commission is in receipt of many requests for eels, but it has not been feasible to attempt their propagation for the purpose of distribution. Eels are found so generally throughout the country that persons wishing to cultivate them can quite readily obtain them without the assistance of the General Government.

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

*The Wood's Holl Station.*—Preparations were made on an extensive scale for hatching the eggs of the codfish at this station, and during the winter considerable valuable work was done. Early in December Col. M. McDonald and Prof. John A. Ryder visited the station to observe the operations in cod hatching, which were carried on under the direction of Capt. H. C. Chester. The first eggs, 6,000,000 in number, were taken on December 2. Many million eggs were taken during the season from comparatively few fish, and were hatched with a relatively low percentage of loss. In one case, with the use of the Chester apparatus, fully 90 per cent were hatched. The filtering of the water through cotton in the McDonald jars was found to be an improvement; and cones with Captain Tanner's attachment were also used. In some instances the density of the water seemed to be too little, causing a considerable loss of the eggs. Several millions of fry were planted near the station; while early in 1886 about 500,000 fry were sent to Washington, thence to Pensacola, from which point they were carried by a revenue-cutter some 25 miles out in the Gulf of Mexico and there safely deposited with a loss of only about 10 per cent.

### b. The White Perch (*Roccus americanus*).

*The Battery Station.*—Several large ripe perch were taken in the seine while hauling it for shad, and their eggs were impregnated and developed in a Chase jar. During the season 1,250,000 perch eggs were thus obtained, and 1,000,000 fry were hatched and planted.

### c. The Whitefish (*Coregonus clupeiformis*).

*The Northville Station.*—The work at this station, which remained under the supervision of Mr. Frank N. Clark, was carried on by much the same methods as formerly in use and shows a satisfactory increase in results over those of the previous year. During November and December, 1885, more than 100,000,000 eggs were received at this station, mostly from the island region of Western Lake Erie and from fish penned at Monroe, Mich. The first eggs came from the spawning beds of Lake Erie on November 11, and the last on December 7. For hatching, the eggs were carried forward in creek water, which is several degrees colder than spring water, until about six weeks before the time of hatching out. Then different lots of eggs were transferred at intervals to spring water, thus causing them to hatch at slightly different times and preventing an overtaxing of the facilities for handling and shipping. The hatching began on March 7 and ended on April 20, the

average period of incubation being 125 days. The temperature of the water used varied from 32° to 43° Fahr., the average being 34½°. The shipments of eggs for the season, amounting to 42,800,000, which is an increase of 11,800,000 over those of last year, were made principally during December and January, of which total, 2,000,000 were sent to the National Fish Culture Association of England; 2,000,000 to the German Fishery Association, through Herr von Behr, its president; 1,000,000 to the Swiss Government; 1,000,000 to New Zealand, by way of California; while the bulk of the stock went to Pennsylvania and Minnesota; 2,000,000 to the central station at Washington; and the rest to three States and one Territory, as well as to all the waters of the Great Lakes. In general, the shipments reached their destinations in good condition, and but a very small percentage of loss was reported. In every instance the eggs were carefully handpicked, and the details of each shipment were carefully attended to. The car work, also, was very successful, owing largely to the employment of two cars instead of one as heretofore, which prevents the accumulation and overcrowding of fry and allows of their disposal while in a vigorous condition. In the nineteen trips the two cars ran a distance of over 10,000 miles, no roads making any charge for this service, except the Chicago and Northwestern. Whenever possible, a tug was procured, from which to make the deposit of fry, care being taken to convey them not less than 2 miles from shore.

*The Alpena Station.*—The work at this station is carried on in conjunction with that at Northville, and 16,000,000 of the eggs taken in at Alpena were repacked and sent to Northville where there are better facilities for shipping. During the season 68,000,000 eggs were received at the Alpena hatchery. Most of this supply came from the west shore of Lake Huron and from Lake Michigan, 20,000,000 being obtained from new territory along the north shore of Lake Michigan where eggs were taken as late as December 16, when the fish were still spawning. The hatching season at Alpena was about a month later than at Northville, but the busy periods at the two hatcheries about coincide.

The number of eggs hatched at both stations for distribution to the Great Lakes was 92,000,000 (distributed from Northville, 52,000,000; from Alpena, 40,000,000), an increase of 4,000,000 over the preceding year, while the number actually planted was considerably greater than last year, owing to slighter losses in transportation. These fry were distributed to the great lakes as follows:

To Lake Huron .....	30,000,000
To Lake Michigan .....	29,000,000
To Lake Erie .....	15,000,000
To Lake Ontario.....	12,000,000
To Lake Superior.....	6,000,000

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92,000,000

*The Cold Spring Harbor Station.*—On January 1, 1885, a case containing 1,000,000 whitefish eggs was received from the Northville station in excellent condition. These eggs were placed in the McDonald jars and hatched well; and 990,000 fry were planted in the deep lakes of Long Island.

d. *The Moranke (Coregonus albula).*

*The Bucksport Station.*—On January 30, 1885, a case containing 50,000 eggs of the small species of *Coregonus* inhabiting Lake Constance, Switzerland, was received at the Cold Spring Harbor station from the hatchery of Carl Schuster in Baden. The eggs were in good condition, and were repacked and shipped to the Bucksport station, which they reached with a loss of only 300 dead. Subsequent losses in hatching left 40,000 fry, which in April were planted in Heart Pond, near Orland, and Lake Hebron, near Monson, in Maine.

Two consignments of the eggs of this fish, aggregating 150,000, were also received from the Deutsche Fischerei-Verein, 100,000 of which were allotted to the Bucksport station for hatching and planting in Maine waters, and 50,000 were sent to the Northville station for stocking suitable lakes in the Northwestern States.

It appears from the proceedings of the Acclimatization Society of France in 1885 that while the United States was receiving eggs of *C. albula* from Germany the above-named society was also being favored by the Deutsche Fischerei-Verein, 100,000 eggs having been received at Paris in the spring of that year. M. Raveret-Wattel, secretary of the society, reports it to be an excellent species for introduction into the lakes of Northern Europe and of especial value to the fresh waters of France, such as the lakes of Auvergne.

Of it Herr von dem Borne says: "It is a very fine fish found in deep lakes of Northern Germany, growing to one or one and one-half pounds weight."

The following description of *Coregonus albula* is by the late Prof. B. Benecke, of Königsberg:

The body is six times as long as it is high, and 2 to 2½ times as high as it is thick; the head is pointed; the snout does not have a blunt end; the lower jaw projects a little, and its thick chin fits in a shallow cut of the middle jaw. The jaws have no teeth; only the tongue has very diminutive and tender teeth. The shape and position of the fins resemble that of other kinds of *Coregonus*. The color on the top is bluish-green, on the sides and belly silvery; the dorsal, ventral, and caudal fins are gray, and the other fins colorless. The millets are much more slender than the spawners. The small *Marane* is found in nearly all deep lakes of the Uralo-Baltic range from Russia to Mecklenburg, also in the southern part of Scandinavia and in Finland. Generally living in deep water where they feed on small crustaceans, worms, and muscels, they come to the surface only at night, especially during warm summer nights, when they sport in the water so that the splashing can be heard for some distance. In November and December they go into shallow water for the purpose of spawning, generally only at night, and leaping about in an exceedingly lively manner, and making a great deal of noise they drop each from 2,000 to 5,000 eggs, about 2 millimeters in size, into the water. The eggs sink to the bottom, and generally ad-

here to the petioles of aquatic plants which are, with hardly an exception, found in all spawning places. In larger lakes the *Coregonus albula* regularly wanders about in large schools; thus, *e. g.*, in September and October they leave the Mauer Lake and the Lowentiu Lake in East Prussia and go into the Spirding Lake, to return again in spring. In most of the lakes this fish reaches a length of 12 to 15 centimeters; but in many waters, *e. g.*, the Dadey Lake, near Bischofsburg, the Lyk Lake, near Lyk, and many others, it reaches a length of 20 to 35 centimeters. As it is highly esteemed on account of its delicate meat, this fish is caught in large numbers with nets and seines, and is brought into the market either fresh or smoked.

e. **The Grayling** (*Thymallus tricolor*).

The Michigan grayling is native to the waters of only a small portion of Michigan, but is also found in the headwaters of the Missouri, in Montana, and in the region of the Yellowstone Park. It never occurs south of latitude 43° north, and its principal habitat on this continent is, or was until recently, in the northern part of the southern peninsula of Michigan, in the clear, cold, rapid streams emptying into Lakes Michigan and Huron, especially in the Manistee and Au Sable Rivers.

The Michigan grayling was first called to the attention of local scientists in 1854 or 1855, and it was described and locally known as *Thymallus michigansis* up to 1864, when its present name of *T. tricolor* was given it after a careful examination by Prof. E. D. Cope. The Fish Commission Report for 1872-'73, printed in 1874, contained a valuable article on this fish by the late James W. Milner.

The average size of the grayling is about 10 inches in length and 8 ounces in weight; though they have been taken 16 inches long and weighing 2 pounds, and even more. It is said to be equal to the brook trout in flavor, and is one of the gamiest of fish; but, unlike the trout, it is more likely to be found in the swift ripples and shallows than in the quiet pools of the stream. While the adult trout and grayling live together in harmony, the eggs and young of the latter often furnish a dainty meal for the trout, and hence the grayling is being driven from streams which are congenial to the trout.

Thirty years ago the grayling were very abundant in some of the streams and rivers of Michigan; but of late years they have been disappearing so rapidly that their final extermination in this region is feared, unless something is done to prevent it. This disappearance is due somewhat to excessive fishing, but largely to the migration or introduction of the trout into the famous grayling streams, and perhaps still more to the settling up of the country and the consequent increase in lumbering. The grayling spawns in spring, about or immediately preceding the beginning of running the logs down the streams, generally spawning in the body of the stream where the water is not very deep. Then the logs come down, driving off the fish, raking up the beds, and destroying the spawn.

In favorable waters this fish is prolific (more so than the brook trout), yielding an average of from 3,000 to 4,000 eggs per spawner. Its spawning season seems to range, in Michigan, from about the middle of March

to the middle of April, according to the severity of the season. In 1878 it was found that the spawning season in the Manistee was about over on March 30; while in 1885 the last eggs were taken in the Manistee on April 24, and in the Au Sable on April 18.

Several attempts have been made to propagate the grayling, but all without much success. Some have gone so far as to hold that it is beyond the reach of artificial fish-culture, but it has been done on a small scale with a slight measure of success, and may succeed with more experience, as the previous work has been largely experimental. In the spring of 1876 there were handled at the Northville station 2,000 eggs taken from grayling caught by Mr. Fred Mather, and a small percentage hatched; and in April, 1885, 20,000 eggs were taken from fish caught with hooks in the Au Sable and Manistee Rivers, and the hatching was fairly successful, but heavy mortality occurred after hatching, as no suitable food was found for the young fish. Those that lived, however, did well and grew rapidly. The Michigan State Fish Commission has made several experiments in cultivating this fish, but all without definite result. Experience seems to show very clearly that the grayling will not successfully endure domestication or confinement in trout ponds, as in 1884 the Michigan Commission placed a number of adult grayling in its trout ponds at Paris, Mich., but not a fish has spawned or showed the slightest inclination to do so, while they have gradually died, till but few are left. Experiments in this line will probably be continued under more favorable and natural conditions. Credit is due to Mr. Martin Metcalf for first obtaining the eggs artificially from grayling reared in the ponds of the Michigan Fish Commission, and for impregnating and hatching the same. This was done in the winter of 1879-'80.

*The Wytheville Station.*—In the spring of 1885 about 300 grayling were hatched from eggs collected from wild fish in the streams of Michigan by Mr. F. N. Clark and forwarded to Wytheville. These 300 fish are being kept for breeders, and at the close of the year were in fine condition.

*f. The Brook Trout (Salvelinus fontinalis).*

*The Northville Station.*—The work of the past season may be regarded as fairly successful, though not so much was done as usual. In all, 225,000 eggs were obtained; from which number, 145,000 eggs were shipped, 25,000 fry hatched, and 25,000 eggs sent to the Michigan fish commission at Paris, Mich., in exchange for an equal number of eggs of the same species which were hatched at Northville and mostly retained for breeding purposes. Of the 145,000 eggs shipped, 36,000 went to Mr. Fred Mather, 25,000 of which were reshipped to the Deutsche Fischerei-Verein of Germany, 10,000 to the National Fish Culture Association of England, and 1,000 to the Government of Switzerland, the rest being distributed among State commissioners and private appli-



cants. There were shipped to Indiana and Michigan 4,000 fry during April and May, while the remaining fry were kept to replenish the ponds. During June 305 yearling and two-year-old wild trout were taken from the streams of Northern Michigan and brought to the Northville Station. During March, April, and May 550 yearling brook trout were distributed from the station to six private persons in Michigan, Indiana, and Ohio.

*The Cold Spring Harbor Station.*—During January 7,000 eggs were received from the Northville Station, from which about 5,800 healthy fry were obtained. These fry, with 10,500 others from eggs taken at the hatchery, were planted in streams of Long Island.

g. *The Lake Trout* (*Salvelinus namaycush*).

The demand for some species of fish other than carp for pond culture is growing so rapidly that it bids fair to equal that which has heretofore existed for carp. In ordinary ponds fed by surface water, the summer temperature of which rises above 60°, some species of *Centrarchidæ* would probably be best. There are, however, all over the Northern States facilities for the construction of ponds by damming back spring branches in which the summer temperature of water is certainly too low for the proper cultivation of carp. To supply the desideratum in reference to this it will be necessary to provide some species of *Salmonidæ* adapted to pond culture. The California trout and the lake trout—especially the latter—would seem to be best adapted to the purpose. The experiment should be made on such a scale and under such variety of conditions as will thoroughly test its feasibility. Believing that the lack of success heretofore experienced in planting *Salmonidæ* has been due to their helpless condition when planted, it seems advisable to hold them until they have attained a length of 5 or 6 inches, when, from their size and vigor, they are almost safe from the attack of predaceous fishes that may be in the water. A trout of the size and age indicated would seem to have as fair a probability of life as a full-fledged birdling. One hundred such placed in a stream or pond, under natural or artificial conditions which are favorable, would give a better promise of success than the planting of 10,000 fry under the same conditions prior to the absorption of their sacs.

*The Bucksport Station.*—For the purpose of furthering the experiments indicated, Mr. Clark was directed on November 14, 1885, to forward to Bucksport, from the eggs then ready for distribution, 50,000 lake trout eggs and an additional 50,000 as soon as they were ready. Mr. Atkins was instructed to retain as large a number as he could safely care for, planting the balance in suitable waters in the vicinity. It was thought that the fry could be retained in the hatching-troughs until the following May or June, which would meantime give an opportunity to make provision for them in the ponds. The 100,000 eggs safely reached Bucksport and were hatched without material loss, and in the middle of May, 1886, were still in good condition.

*The Northville Station.*—The work done with this species during the past season was more than three times as great as that of any preceding year. The number of eggs collected was 1,475,000; of which 1,031,000 eggs were shipped away, and 115,500 fry hatched. During the winter and spring 75,500 fry were sent to various points in Michigan, Indiana, and Ohio, while 40,000 fry were retained at the hatchery. Thus there was a total of 1,146,500 eggs and fry successfully handled. More eggs were taken at Thompson, Mich., on the north shore of Lake Michigan, than at any other point, though this was the first attempt in that region, while many were also taken from the island shoals of Thunder Bay and vicinity in Lake Huron. The eggs were taken by Mr. S. P. Wires and his assistants, of the Alpena station, and were at once forwarded to Northville, with scarcely any loss in transit. Of the eggs distributed, 50,000 each were reshipped by Mr. Fred Mather to the Deutsche Fischerei-Verein of Germany, the National Fish Culture Association of England, and the Government of Switzerland; while 25,000 were sent to Mexico. The remaining were shipped to twelve States and to the central station at Washington. As far as known, all of these shipments arrived in good condition, except that to Mexico, which was too long on the way and was probably exposed to too high a temperature.

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

*The McCloud River Station.*—Mr. Livingston Stone retains the general superintendence of this station, while Mr. Loren W. Green was there in person to attend to the actual work during the season. The spawning began a little later this year than heretofore and did not last as long as usual, the first eggs (15,000) being taken on December 27, 1885, and the last (3,000) on April the 29th following. A violent storm visited the river just before the beginning of the spawning season, which caused some injury to the trout by making the water in the ponds very muddy. This storm was followed by a remarkably dry winter, which was unfavorable to the taking of spawning trout and caused very few eggs to be obtained in April. A total of 313,600 eggs was taken during the season, which was very creditable under the circumstances. Of the 246,000 eggs sent away, with the exception of one lot to Washington that was frozen in transit, all were received in good condition, and Mr. Green's method of packing seems very satisfactory. There were hatched and planted in the McCloud River 28,700 fry, and 11,300 were hatched for the ponds at the station.

Early in the fall the trout in the McCloud River and in the ponds were observed to be dying from some unknown disease. The symptoms were peculiar, and the disease seemed to be contagious, being apparently communicated to those in the ponds by the fish caught in the river, and attacking chiefly the larger trout. This has probably greatly reduced the number of spawners for the season of 1885-'86.

*The Northville Station.*—During the season 167,000 eggs were taken, of which number 5,000 were shipped and 30,000 were hatched, while the remainder died in the hatching-boxes. Of the 30,000 hatched a large percentage died within six weeks, in spite of the greatest care and attention, while no more than 5,000 survived. These small returns indicate that this species of trout does not successfully become acclimatized in the waters of the station, although special efforts have been made for a number of years to bring about this result. A total of 3,364 yearling and two-year-old fish were distributed by means of car No. 2 and special messengers for stocking streams and lakes in Indiana, Michigan, and Ohio.

*The Cold Spring Harbor Station.*—During February and March 20,000 eggs in good condition were received from the Northville Station. These hatched very well, and 14,500 fry were planted in streams of New York, mostly on Long Island.

*The Wytheville Station.*—From this station there were forwarded to applicants 30,000 eggs, while 166,000 were retained to be reared. The distribution from Wytheville was made to the headwaters of the Shenandoah, in Augusta County, Virginia, to tributaries of the Potomac in Washington County, Maryland, and to a number of spring-fed, cold-water ponds in Maryland, Southwestern Virginia, and Tennessee.\*

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

*The Bucksport Station.*—Mr. Charles G. Atkins remained in charge of this station, the operations being conducted as formerly by the United States, the Maine, and the Massachusetts Fish Commissions. The breeding salmon were purchased, as heretofore, from the Penobscot River fishermen, beginning on June 1 and ending on June 20. In all, 691 were

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\* Writing under date of July 28, 1885, Colonel Marshall McDonald says:

"I had the seine drawn yesterday in one of our ponds containing California trout (breeders). I found them in splendid condition, but not averaging as large for their age as they will hereafter, as our original stock was badly handled at the start, and stunted. Many of them will, however, average from 2 to 2½ pounds, and from the whole, barring accidents, we ought to get not less than 150,000 to 200,000 eggs next season. We have lost but one breeding fish this season, and that I believe was choked. Last year during the hot weather we lost about 1,100 two-year-old fish; then the wooden tanks or ponds in which the fish were kept were entirely above ground. Since then I have had them banked around with earth and the upper ends of the ponds filled in with clay, gravel, and bowlders. The present fine condition of the fish I attribute to these changes. The new ponds on the hillside below the hatchery all have earth bottoms, and the advantage is seen in the remarkable growth of the fish in them; some of the yearlings are now 8 inches to 9 inches long. This spring's hatching (the fish are now about four months old) will range from 3½ to 4½ inches long.

"I regret very much to have to report that the losses in the California trout after they began feeding were very great, and we will not have over 30,000 for distribution. This mortality Mr. Seagle attributes to the fact that the fry had to be held in the hatching-troughs long after they had begun feeding. I think he is probably right; at any rate, this cause of loss will no longer exist, as we shall hereafter be able to place the fry on earth-bottom ponds as soon as they begin feeding."

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obtained, of which number 610 were placed alive in the inclosure of a part of Dead Brook, 81 having perished in transit from the excessive heat of the river water. At the spawning season 501 were recaptured, being about 82 per cent of those placed in the inclosure, and 72½ per cent of all those obtained.

The size of the salmon this year was small. At the spawning season, when most of the fish were weighed, the females averaged 12¾ pounds before spawning, and the males averaged 10 pounds; the average length was about 31 inches, and the females yielded an average of 8,667 eggs apiece. The spawning, which was accomplished between October 27 and November 5, furnished nearly 2,500,000 eggs. The available stock of eggs, after losses were deducted, was 2,316,000, of which number 1,000 were kept for experiment, while the remainder were shipped to the order of the contributors to the fund, as stated below. The transfers were made with exceedingly small loss.

Contributor.	Amount of contribution.	Computed share of eggs.	Eggs actually delivered.
United States .....	\$1,899 71	1,254,000	1,251,500
Maine .....	1,000 00	683,500	683,500
Massachusetts .....	600 00	397,500	400,000
	3,499 71	2,315,000	2,315,000

The share of the United States was sent agreeably to orders as follows :

To Cold Spring Harbor, New York.....	500,000
To Plymouth, N. H., for New Hampshire.....	150,000
To Plymouth, N. H., for Vermont.....	150,000
To Maine .....	451,500

*The Cold Spring Harbor Station.*—This was the second year of the operations with these fish at this station, and the work was very successful. During January eight cases containing 500,000 eggs arrived in good condition from the station at Orland, Me. Of the 425,000 hatched and planted, including a small loss in transportation, 270,000 were deposited in the tributaries of the Hudson, 100,000 in the tributaries of the Delaware, 50,000 in Oswego River, and 5,000 were distributed in small lots. Favorable accounts have been received of the plantings in Clendon Brook, from which it seems that this stream is becoming well stocked. Later reports indicate that salmon are again found in the Hudson, probably from the planting of 1882.

j. *The Landlocked or Schoodic Salmon (Salmo salar var. sebago).*

*The Grand Lake Stream Station.*—The work of this station continued under the supervision of Mr. Charles G. Atkins. The fishing lasted from October 24 to November 18, resulting in the capture of 811 fish, about three-fourths of them being females. In length the fish averaged

about the same as those of 1884, but there was a slight decrease in weight (from about 4.1 to 3.6 pounds), and a considerable falling off in the average number of eggs to the spawning female (from 2,350 to 1,720).

The station is operated jointly by the U. S. Fish Commission and the State commissions of Maine, Massachusetts, and New Hampshire, and the eggs obtained are allotted according to contributions to the expenses of the station by the commissions. The expense during the present year (\$1,678.01) was distributed as follows: United States, \$578.01; Maine, \$500; New Hampshire, \$300; Massachusetts, \$300.

Total production of eggs for the season .....	994,355
Losses during incubation .....	127,655
Available for distribution .....	866,700
Hatched at the station and returned to Grand Lake stream (less a loss of 891) .....	225,700
Available for pro rata distribution .....	641,000

Which were allotted as follows:

To the U. S. Fish Commission .....	222,000
To the Maine Fish Commission .....	183,000
To the Massachusetts Fish Commission .....	115,000
To the New Hampshire Fish Commission .....	115,000
	641,000

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

To the Deutsche Fischerei-Verein, Germany .....	20,000
To the National Fish Culture Association, England .....	20,000
To State commissioners and individual applications .....	182,000
	222,000

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 Northville Station.*—On March 19 a case containing 29,000 eggs was received from the Grand Lake Stream Station in excellent condition, and on April 14 hatching was completed with a loss of only about 600. A few weeks later 22,000 fry were planted in streams in the northern central portion of Michigan.

*The Cold Spring Harbor Station.*—In March 60,000 eggs were received from the Grand Lake Stream Station in excellent condition. It was intended to plant the fry in some of the Adirondack lakes, but through some misunderstanding the fish were kept too long, and were finally deposited during May in lakes on Long Island.

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

*The Northville Station.*—A few of the German trout reared at this station spawned in December, 1885, and 8,000 eggs were obtained. Two

lots of eggs, 23,000 in number, were forwarded from the Cold Spring Harbor Station, the second lot of which (13,000) arrived in poor condition. From these 31,000 eggs 20,000 fry were hatched, which were retained at the station. The stock fish of this species in the Northville ponds show a better growth than the brook trout, and the outlook for the future is very promising.

*The Cold Spring Harbor Station.*—In February a box containing 40,000 eggs in very good order was received from the German Fischerei-Verein through its president, Herr von Behr. The fry from these eggs, which when hatched and ready for distribution amounted to about 28,000, were mostly planted on Long Island and near the Hudson, while a few that were kept at the station grew remarkably and are handsome and game fish.

During the year eggs were taken by several other persons, as well as at the Cold Spring Harbor Station, from fish which had been bred from eggs sent over from Germany two or three years before. The average number of eggs taken in one case (the fish being three-year-olds) was 540, and there are indications that this yield will increase. This indicates that this valuable fish has been successfully acclimatized in this country, and their cultivation may be greatly extended, as they are considered superior in many respects to our native brook trout.

*l. The Loch Leven Trout (Salmo levenensis).*

*The Northville Station.*—On January 2, 1885, six cases, estimated to contain 102,000 eggs, were received at the Cold Spring Harbor Station from the Howietoun hatchery in Scotland. They were in remarkably good condition, only 870 being dead. Mr. Mather sent 10,000 of the eggs from the Cold Spring Harbor Station to the Bisby Club, in Herkimer County, New York, where they were received in good condition, and the young trout are reported as doing very well. The remainder were shipped to the Northville Station, where they arrived on January 7 in excellent condition, there being practically no loss on the eggs. Of the eggs, 55,000 were thence reshipped to other stations, while 36,500 fry were distributed in Michigan and 7,000 young retained at the hatchery for breeding purposes.

*The Bucksport Station.*—During February, 1885, a case of 10,000 eggs was received from the Northville Station by way of Grand Lake Stream. At this last place they were in excellent condition, but they were partly frozen before reaching Bucksport; about 3,000 were lost, and the remaining 7,000 fry were planted on May 4 in Branch Pond and its tributary brooks near Ainsworth, Me.

*m. The Quinnet or California Salmon (Oncorhynchus chouicha).*

*The McCloud River Station.*—Active operations in taking the eggs of this fish were suspended at this station during the year. There was a very small run of salmon in the river, and it is feared that unless some-

thing is quickly done the Sacramento River will soon be depleted of its most valuable fish.

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

*The Fort Washington Station.*—For the two years previous to the season of 1885 the eggs collected from shad taken in the vicinity of Fort Washington were transferred to Central Station, in Washington City, where they were hatched and whence the young fry were distributed to suitable waters. In February of 1885 this work was reorganized under the direction of Col. Marshall McDonald, who made Fort Washington the headquarters of the collecting force, where all the eggs taken were held pending convenient transportation to Central Station on the river steamers.

An inspection of the Fort Washington Station showed the desirability of an additional building to be used exclusively for holding the eggs and keeping them in good condition until shipped. Accordingly such a building, 16 by 22 feet, was erected, and equipped in time to receive the first eggs taken. Mr. James Carswell was placed in immediate charge of the station, and on March 30 took possession with a part of his force, the others being called in as the season advanced and the work required it. By April 5 the station was fitted for service, but there being no shad in the river the seine was not regularly fished till the 16th, and no eggs taken till the 20th, when the temperature of the river was still low (52° Fahr.). After that date the temperature steadily rose, and up to May 28 an average number of eggs was taken daily, after which date there was a gradual decrease until the 5th of June, when the last eggs for the season were obtained. The total of 22,576,000 shad eggs were obtained during the season, more being derived from the Fish Commission seine at the station than from any other source, while the largest amounts for the season were taken on May 5 and 6, over three and a half millions of eggs being secured on those two dates. From eggs retained at the station 1,000,000 fry were hatched and planted in the Potomac. The gilliers and the fishermen at the different shores in the vicinity rendered valuable assistance, having furnished over 15,000,000 eggs. It may be noticed that for the entire season the number of females was considerably in excess of the number of males, the proportion being 54.3 per cent; while the proportion of ripe females to the number of females taken was 17 per cent. Also it may be stated, as generally applicable to the shad in the Potomac, that the average yield of eggs per ripe female was 28,888.

*Central Station.*—After the eggs had been held at Fort Washington for periods varying from twelve to thirty-six hours, they were forwarded to the Central Station in charge of a special messenger. The total number of eggs thus forwarded was 21,019,000; of which number, 16,536,000 reached the station in good condition, and yielded 14,791,000 fry for distribution. The aggregate number of eggs received at this station

did not vary greatly in the past three years, though a little the smallest in 1885, but the production of young for distribution was larger during this last season than in either 1883 or 1884.

Records were kept of the different lots of eggs, thus securing data of their impregnation, temperature of water, time of hatching, &c. From these it is seen that, under the same conditions of temperature, the period of time from impregnation to hatching varied from a few hours to several days, thus indicating that the period of incubation does not simply vary inversely to the temperature as indicated by the thermometer. It is suggested that the increased temperature produced in the eggs by the action of either direct or reflected sunlight, but which cannot be measured accurately by any instruments now known, may have much to do with this varying development. The earlier runs of shad habitually spawn in a lower temperature than those which come later in the season. It may be, therefore, that a difference in the rate of development of separate lots of eggs is to some extent a matter of heredity. In general, however, it seems to be indicated clearly by the record that the lower the temperature during incubation the longer does this period last.

In making the distribution from Central Station, which was done by car and messenger service, care was taken to stock liberally the Potomac, Susquehanna, and many of the lesser tributaries of the Chesapeake, which it was supposed would furnish suitable nurseries for the young fish during the first summer of their existence.

The general planting of shad fry, summarized by regions or drainage basins in which they were deposited, was about as follows:

To tributaries of Chesapeake Bay.....	8,588,000
To Hudson River.....	1,250,000
To Palmer River, tributary of Narragansett Bay .....	825,000
To tributary of Albemarle Sound .....	1,500,000
To tributaries of the Atlantic south of Albemarle Sound .....	1,475,000
To minor tributaries of the Gulf of Mexico .....	2,349,000
To tributaries of the Mississippi River in Illinois.....	1,104,000
To tributaries of the Mississippi River in Kansas .....	872,000
To Colorado River of the West, tributary of the Gulf of California.....	848,000
To tributaries of the Columbia River .....	60,000
<b>Total .....</b>	<b>18,871,000</b>

The results of the work of shad production on the Potomac River during the season may be summarized as follows:

Number retained at Fort Washington Station .....	1,557,000
Number forwarded to Central Station.....	21,019,000
<b>Total number of shad eggs collected on the Potomac River, season of 1885.....</b>	<b>22,576,000</b>
Number of eggs received at Central Station in good condition.....	16,536,000
Number of eggs shipped to other points .....	325,000
<b>Number of eggs hatched at Central Station .....</b>	<b>16,211,000</b>



Number of shad fry planted in the Potomac River at Fort Washington Station.....	1,000,000
Number hatched and distributed from Central Station .....	14,531,000
Total product for distribution from Potomac River stations.....	15,531,000

The average loss from impregnation to the period of hatching was 31 per cent.

The average loss during incubation at Central Station was 10 per cent.

The cost of production was, in round numbers, at the rate of \$330 for each million shad fry furnished for distribution, or more than 30 young shad for each cent of expenditure.

*Battery Station.*—This station was continued under the superintendence of Mr. William Hamlen much as it was in 1884. Advantage was taken of every opportunity to make the work successful, and although the results of 1885 were almost three times as great as those of the previous season, the capacity of the station was by no means developed to its utmost.

The system followed in 1884, of fishing the seine by contract, not having resulted so satisfactorily as was hoped, a different plan was adopted and the seine was operated under the direct management of employees of the Commission, an experienced fisherman being engaged to act as captain of the seine.

The season was unusually backward, owing to the prolonged presence of ice in the river. The time during the earlier part of the season, however, was occupied in removing obstructions from the seine-hauls and in getting ready for the season's operations. Frequent storms, the muddy condition of the water, and the troublesome state of the apron upon which the seine was landed were all influential in keeping the catch of shad below what was anticipated. The first haul of the seine was made on April 16, and it was thereafter worked regularly and thoroughly until the 27th of May, during which period one hundred and nine hauls were made; the total catch of shad was 3,512, only 42 being ripe females. During the entire season, which ended on June 11, the total number of eggs obtained from the seine, from gilliers, and from other sources was 13,357,000. From these, 10,292,000 fry were hatched and 433,000 were received from the steamer Lookout, making a total of 10,725,000; of which, 5,044,000 were planted in local waters, and 5,681,000 were shipped away by car and messenger service and deposited in various suitable localities.

Experiments were repeated this season in confining unripe shad in the pool, but with little or no success. At intervals the shad were removed and examined, most of them proving utterly unsatisfactory, while the few eggs taken refused to hatch. A troublesome feature was noticed in this connection, in consequence of the water used in the hatching-jars being pumped from this pool. The pollution of the water in the pool caused such danger to the eggs in process of hatching that finally the fish were allowed to escape, after which the eggs resumed their normal condition. This difficulty could be obviated, of course,

for another season by getting the supply of water elsewhere; but the experiments thus far conducted in penning shad seem to indicate that this is not an advisable means for obtaining eggs.

*Fish Hawk assistance.*—In the early work preparatory to opening the season the Fish Hawk, under the command of Lieut. L. W. Piepmeyer, rendered assistance at Battery Station by dragging the seine-haul and clearing it of obstructions. Most of the shad work of this steamer, however, was done on the Delaware River.

As stated elsewhere, on May 23 the vessel was in the Delaware, and from this date to the 10th of June the fishing-shores were visited, information relative to the work was gained, and eggs were collected to the number of 10,604,000. From these, 8,063,000 fry were hatched on board, all of which were deposited in the Delaware River. At the time the Fish Hawk arrived on the Delaware, the fish had evidently been spawning for some time; and with an earlier start the work of the season could have been much increased.

*Lookout assistance.*—On May 8 the hatching equipment was taken on board the steamer Lookout, commanded by Mate James A. Smith, and on the 13th the vessel proceeded to Battery Station to assist in the operations in that vicinity. This was done by tending gill-boats, transferring spawn-takers to and from suitable points, and in collecting and transferring shad eggs, thus handling 1,406,000 eggs.

From May 17 to June 5 the Lookout was engaged in two trips to the Delaware River and one in the upper part of Chesapeake Bay, procuring eggs and investigating the fisheries, particularly those of the Delaware above Philadelphia. Many fishermen were interviewed as to the condition of the fishery, and the spawn-takers were kept busy in visiting fishing-shores and gill-boats to obtain eggs. The total number of eggs taken by the Lookout during the season was 4,409,000; and from this number 2,115,000 eggs and 454,000 fry were transferred to Battery Station, and 340,000 fry were successfully planted, 190,000 being put into the Delaware River and 150,000 into the Chesapeake Bay and its tributaries.

*Experiments in planting shad.*—In 1884 a shipment was made to the Colorado River of the West. This experiment was repeated in 1885, and 848,000 fry were planted in good condition. Should these attempts at stocking this region result successfully, the fry deposited in 1884 would probably reappear as mature fish in the spring of 1887 or 1888.

The reasons for selecting the Colorado River for stocking were as follows:

1. The Colorado is free from alkaline salts and of a suitable spring and summer temperature; the other physical conditions are also favorable.
2. The Colorado empties into the Gulf of California, which extends south for 700 miles before reaching the open ocean; and it is thought

that the warm waters of the lower part of the gulf would be a barrier to keep the shad from being lost in the Pacific. The shad then would return to the Colorado and Gila to spawn.

It is believed that the rivers of Washington Territory draining into Puget Sound can be stocked with shad and be made to furnish profitable fisheries, the importance of which to that region can scarcely be overestimated. In order to try the experiment, 900,000 vigorous fry were selected, and sent off with much care, the distance being such as to require all the time during which shad fry can be transported with safety. A detention of three days by the washing away of a bridge resulted in almost total loss, but 50,000 were planted alive in the Willamette River at Portland, Oreg. A small shipment of 10,000 was also planted without any appreciable loss at Ainsworth, Wash., in the Snake River, near where it empties into the Columbia.

*The Gloucester City Station.*—This station on the Delaware was in operation this year for the first time. The steamer Fish Hawk, commanded by Lieut. L. W. Piepmeyer, secured over 10,000,000 eggs between May 23 and June 10, the period during which she was stationed at this point.

The steamer Lookout, Mate James A. Smith commanding, also procured shad eggs from the Delaware, the greater part of which were transferred to Battery Station.

The following remarks of Mr. A. M. Spangler, a member of the Pennsylvania State Fish Commission, show at once some of the difficulties which are encountered in restocking our streams, as well as the high appreciation of the Pennsylvania commissioners and of the people of Philadelphia of the efforts made by the U. S. Fish Commission in their behalf. Mr. Spangler's letter, dated Philadelphia, June 22, was published in the Philadelphia Press of July 4, 1885, as follows:

Your reporter quotes me as saying that "the feat of the U. S. Fish Commission in dumping millions of young shad into the Delaware was as sensible as throwing them on the Jersey sands." In order that the true meaning of the remark may be understood, it is proper to say that it referred wholly to the planting of shad fry in the Delaware in the immediate vicinity of Gloucester. It is not necessary to state the reasons for such an opinion. They are obvious to all who have given the subject a moment's consideration.

As to the restocking of the Delaware with shad I have only to say that I have the most implicit faith in it, and can only regret that the kindly efforts of the U. S. Fish Commission, supplemented as they have been by those of the fishery commissioners of Pennsylvania and New Jersey, have not met with full appreciation at the hands of many of the residents along the stream.

The shad naturally seeks the upper waters of a stream to do its spawning. Hence that is the place where the young fish hatched on the Fish Hawk or elsewhere should be planted, and there is where I understand the planting is being done. The great drawback to this is that those upper waters abound in fish-baskets, the most infernal contrivance ever devised by man for the destruction of young shad. Though not intended for that purpose, yet such is their certain effect.

I have it on the authority of a former fish commissioner of this State, also upon that of Mr. F. M. Ward, of the New Jersey Commission, that it has not been an uncommon

thing for farmers to haul away a wagon-load of small shad intercepted by and drowned in those deadly fish-baskets, and use them for fertilizing purposes. It is to this more than to any other single cause that the gradual and steady decline in the shad yield of the Delaware is attributable.

If the people living along the river were as fully alive to their own and the general public interest as they should be, they would at once and forever rid themselves of those most indefensible violations of statute law; for the law expressly condemns and forbids them. If the State fish commissioners were provided with the means wherewith to compensate wardens, the evil could be remedied; or if the sheriffs and constables of the counties bordering on the river had proper respect for their sworn obligations, the outrages could be prevented. Possibly the legislature will in its wisdom grant the appropriation asked for by our board of State fish commissioners, in which event fish-baskets will have short leases.

But for the restocking of the Delaware by the commissioners already referred to the shad supply of that river would be much less than it is. With additional hatching facilities, with a proper observance and a somewhat more extended close season, and the complete abolishing of illegal fishing, that supply would certainly be quadrupled. It requires little calculation to demonstrate that such a result would prove hundreds of thousands of dollars in value to the States of Pennsylvania and New Jersey.

Allow me to say in conclusion, then, that the people of Philadelphia, as well as those residing on both sides of the Delaware, from its mouth to its source, owe a large debt of gratitude to Prof. Spencer F. Baird, of the U. S. Fish Commission, for the unselfish and happily successful efforts he and his assistants have been and are making in the behalf of the fishing interests of that stream. The sending of the Fish Hawk into the Delaware, the hatching of shad on board of her, and the shipping to and planting of the young fry in its upper waters, which are the natural spawning-grounds of the shad, are kindnesses and compliments meriting much higher appreciation than appears to have been accorded them by the general public.

*The Lambertville Station.*—Car No. 3, in charge of J. Frank Ellis, with complete shad-hatching apparatus, arrived here about the first of June and a temporary station was established. It met with fair success during its stay, and left about the middle of July. This is the first time any of the cars of this Commission have been used as a shad hatchery.

*Experiments in raising shad in the carp ponds at Washington.*—On June 14, 1885, a lot of just hatched young shad, brought over from Central Station in eight fish-cans, was planted in the northwestern part of the west pond, in the so-called old canal. In the same pond, which is about 5 feet deep at one end, were kept 100 good-sized carp which had spawned a fortnight before, and the young carp were in excellent condition.

On July 20 the first young shad was noticed, which was then about half an inch long. Eight days later they were from three-fourths to one inch in length; on August 14 they were from 2 to 2½ inches long; September 20, from 3 to 4 inches; and October 1, from 4 to 4½ inches in length.

During the summer almost no fish could be seen during the daytime; but after sunset, when they were seeking for food, hundreds were visible jumping about, sometimes leaping about a foot out of water, catching mosquitoes and small flies.

On November 4 the water was drawn out of the pond in order to catch the carp for distribution. The shad found in the pond were from 5 to 7 inches long and from 1 to 1½ inches broad through the body. It is well known that the shad is a very tender fish; and as the water became lower and lower many of them died in the shallow water. Dr. Hessel counted over a thousand that died in this way, though they had plenty of water in which to swim.

He made several attempts to keep a few hundred of the shad alive, but without much success, as nearly all died after being transferred from the pond to the tub or tank. The whole number of shad was about 7,850, of which about 7,500 were sent to the Smithsonian Institution, and 200 of the rest died within two days in a tank with running water. Fifty of the living fry were put in the east pond, where there were no other fish. On December 10, 1885, there were still about 40 alive on the island, in a tank with running water. Efforts to keep them alive by feeding them were made, but without expectation of success, as they want living food, such as small crustaceans, &c., which can scarcely be found in the water during the cold season.

In addition to the shad and carp in the pond, there were also some herring, and winter shad, and about 3,000 young sunfish and 10 large ones. The herring and winter shad came in as spawn or young fry through the fine-wire screen when the supply of water was coming in from the Potomac on April 25. The young sunfish, which were from half an inch to 3 inches long, were the fry of the large ones, which were about 5½ inches long and 3½ inches high from dorsal to ventral fins. The large sunfish were probably thrown in by boys who had caught them from the river, as it does not seem likely that they could have come through the screen on April 25, and the pond had lain entirely dry during the six weeks before this.

On December 11 Mr. Barton A. Bean, speaking of the table qualities of these fish, said: "I have tested the edible qualities of the young shad and have found them palatable and appetizing, I would say similar to the whitebait, but not equal to the anchovy. Quite a number of the National Museum employees tried these fish, and all speak very highly of them."

*o. The River Herring (Clupea aestivalis).*

*Battery Station.*—During the season, 167,125 herring were taken in the seine at this station in connection with the shad work. Some of these were confined in the pool with the shad. Attempts were made to hatch the eggs of the herring, but the apparatus apparently was not adapted for the work and but little success was attained. By careful management, however, about 200,000 fry were produced and planted in the waters near the station.

*Central Station.*—In addition to the principal work of the station, considerable attention was given to devising a successful method for hatching the adhesive eggs of the herring. Several forms of apparatus

were used without success; and it is thought that the failure should be attributed to the low temperature of the water which prevailed during the experiments.

*p. The Smelt (Osmerus mordax).*

*The Cold Spring Harbor Station.*—Considerable success was attained in hatching these eggs, which, on account of their adhesive nature, give a good deal of trouble. The fish were obtained from streams emptying into Great South Bay, and brought to the station during the first week in March, 120 in number, from which about 200,000 eggs were taken. About 50 per cent of the eggs hatched; and 100,000 fry were liberated in different streams near Cold Spring Harbor.

*q. The Tomcod (Microgadus tomcodus).*

*The Cold Spring Harbor Station.*—The eggs of this species which comes close to the shore and along the docks in November and December to spawn, were taken in milk-pans, after the manner of handling trout and similar fishes. These eggs are not adhesive, nor are they so buoyant as those of the codfish. They hatched in about twenty-five days, and the fry, about 210,000 in number, were planted in the harbor.

*r. The Carp (Cyprinus carpio).*

The cultivation of carp has come to be among the most important of the operations of the Commission. Good results have been manifested in nearly every State and Territory, and the demand for the species is still maintained.

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

Place.	Scale carp.	Leather carp.	Blue carp.
North pond .....		50,000	
South pond* .....		35,000	
East pond † .....		192,500	
West pond .....		50,000	
Arcenal pond .....	25,800		
Canal pond .....		10,500	
Little Island ponds .....			1,600
Total .....	25,800	343,100	1,600

\*This pond was drained October 28 and the increase over past years was very gratifying. In 1884, it produced 12,000 leather carp and in 1883 but 7,000.

†In 1883 this pond produced 60,000 carp; and in 1884, 70,000 carp.

The total distribution for the season aggregated 348,784; of which number 187,414 were sent to individual applicants, and 161,370 were distributed to public waters. The number of individual applicants supplied was 6,273; and the distribution was general, including 1,347 counties in 309 Congressional districts. The distribution to public waters embraced the principal river basins of the Middle and South Atlantic States and the Gulf region.

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Table of German carp planted in public waters of the United States, from October 27, 1885, to March 26, 1886, inclusive, under the direction of Col. M. McDonald, Chief of the Division of Distribution, U. S. Fish Commission.

State.	Date.	Place at or near which.	Waters stocked.	Number of fish.
Alabama	Dec. 8, 1885	Lake near railroad	Lake on A. and W. P. Railroad	500
Arkansas	Dec. 29, 1885	Fulton	Red River	3, 200
Colorado	Dec. 20, 1885	Granada	Arkansas River	5, 000
Delaware	Dec. 10, 1885	Wilmington	Brandywine Creek	500
	Dec. 10, 1885	Wilmington	Christiana Creek	500
	Dec. 10, 1885	Wilmington	Delaware River	500
	Dec. 10, 1885	Wilmington	Shellpot Creek	500
Florida	Dec. 5, 1885	Jacksonville	Lakes near Jacksonville	860
Georgia	Dec. 11, 1885	Way Cross	Satilla River	2, 400
Illinois	Jan. 2, 1886	Aurora	Fox River	1, 000
	Dec. 30, 1885	Carlyle	Kaskaskia River	400
	Jan. 2, 1886	Chicago	Lakes in Lincoln Park	1, 000
	Jan. 2, 1886	Chicago	Lakes in South Park	1, 050
	Dec. 30, 1885	Clinton	Railroad water-tank	200
	Jan. 1, 1886	Dixon	Rock River	1, 000
	Dec. 30, 1885	Equality	Saline River	1, 000
	Jan. 2, 1886	Kankakee	Kankakee River	1, 000
	Dec. 30, 1885	Lancaster	Lanesville Lake	800
	Jan. 1, 1886	La Salle	Illinois River	3, 000
	Dec. 30, 1885	Louisville	Little Wabash River	200
	Jan. 1, 1886	Mendota	Little Vermillion River	1, 000
	Dec. 30, 1885	Mill Shoals	Little Wabash River	400
	Jan. 2, 1886	Naperville	Des Plaines River	200
	Dec. 30, 1885	Pekin	Lake Cooper	100
	Dec. 30, 1885	Riverton	Sangamon River	1, 000
	Dec. 31, 1885	Riverton	Clear Lake	1, 000
	Dec. 30, 1885	Vandalia	Kaskaskia River	1, 000
	Dec. 30, 1885	Wood Lawn	Big Muddy River	400
Louisiana	Jan. 10, 1886	Ponds near railroad	Ponds of Vandalia R. R	2, 520
	Dec. 7, 1885	Delhi	Bayou Macon	1, 000
	Jan. 5, 1886	La Fourche	Bayou La Fourche	1, 000
	Jan. 5, 1886	Monroe	Washita River	2, 000
	Jan. 6, 1886	Quebec	Texas River	1, 000
	Jan. 5, 1886	Rayville	Crew Lake	1, 000
	Dec. 10, 1885	Richland County	Grassy Lake	1, 000
	Dec. 10, 1885	Shreveport	Red River	2, 500
	Jan. 5, 1886	Tallulah	Lake Ono	1, 000
Maryland	Nov. 17, 1885	Battery Station	Susquehanna River	20, 000
Massachusetts	Oct. 27, 1885	Attleborough	Bungay River	200
	1885	Winchester	Tewksbury Reservoir	600
Minnesota	Nov. 4, 1885	Slayton	Lake Beauty	500
Mississippi	Jan. 5, 1886	Jackson	Pearl River	5, 000
New Mexico	Dec. 21, 1885	Albuquerque	Rio Grande River	6, 000
Ohio	Dec. 8, 1885	Youngstown	Mahoning River	3, 000
	Mar. 25, 1886	Zanesville	Muskingum River	3, 750
South Carolina	Dec. 21, 1885	Society Hill	Great Pedee River	600
Tennessee	Nov. 28, 1885	Dyersburgh	Fork of Forked Deer River	1, 000
	Nov. 30, 1885	Fowikes	Fork of Forked Deer River	1, 000
Texas	Dec. 12, 1885	San Marcos	San Marcos River	5, 050
Virginia	Dec. 4, 1885	Brooke's Station	Acquia Creek	6, 250
	Nov. 24, 1885	Charlottesville	Ivy Creek	400
	Nov. 24, 1885	Charlottesville	Rivanna River	1, 000
	Dec. 23, 1885	Chatbam	Banister River	3, 000
	Dec. 23, 1885	Danville	Dan River	6, 000
	Nov. 28, 1885	Junction	North Anna River	7, 000
	Dec. 23, 1885	Lynch's Station	Staunton River	6, 000
	Nov. 27, 1885	Milford	Mattaponi River	8, 000
	Dec. 23, 1885	Otter River	Otter River	5, 000
	Dec. 4, 1885	Potomac	Potomac River	5, 500
	Dec. 4, 1885	Quantico	Quantico Creek	6, 250
	Nov. 15, 1885	Rockfish Depot	Rockfish Creek	200
	Nov. 28, 1885	Taylorville	Little River	5, 000
	Nov. 28, 1885	Taylorville	South Anna River	5, 000
	Dec. 4, 1885	Wood Bridge	Occoquan River	7, 000
Total number planted				161, 370

The following plants and seeds were received at the Carp Ponds of the U. S. Fish Commission at Washington, in March, 1885, from the Royal Gardens at Kew, London:  
 Plants.—*Nelumbium speciosum* (1), *Thalia dealbata* (1), *Sagittaria*

*heterophylla* (6), *Villarsia nymphæoides* (1), *Polygonum amphibium* (1 bunch), *Ranunculus lingua* (6), *Nymphæa alba* (2).

*Seeds*.—*Nelumbium speciosum*, *Nymphæa ampla*, *Nymphæa cyanea* (*stellata*), *Nymphæa lotus*, *Victoria regia* (50).

Under date of July 26, Mr. Hessel reported :

Pond No. 6 now has the richest growth of nelumbiums I ever saw. The vegetation is even with the wire fence and the flowers are about one foot higher, making the growth fully 7 feet high. I counted this morning about 350 open flowers of nelumbiums in this pond. All the nelumbiums in this pond got some bone-dust this spring, and the insects (moths) are almost all destroyed.

*The Northville Station*.—In the fall of 1884 a Fish Commission car when on a western trip left at Northville 1,000 carp. On January 24 of the present year Mr. Clark reported that 800 of them were still in the ponds, several shipments having been made to individuals and a small number having been lost. The loss was due to the carp being placed in tanks in the house for convenience in shipping. But few orders for shipping having been received, the carp were turned into a vacant pond in January, after which there was no loss. The 800 carp were held primarily for the purpose of answering the calls in the spring from people in Michigan whose ponds were not ready the preceding fall.

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

*The Washington Station*.—The propagation of Japanese and common goldfish was carried on as usual under the direction of Mr. Hessel. The number of each variety was as follows: (1) Common goldfish, 3,700; (2) Japanese (including fan-tail), 4,600; total, 8,300.

Mr. Henry W. Elliott, writing from Cleveland, Ohio, September 14, 1885, says that the 25 goldfish received from the U. S. Fish Commission he put into his pond last April, and that they were then only 3 inches long. They have grown to 8 inches in length, and produced thousands of young, so that the pond is fairly alive with them. Some of the young fish are nearly 6 inches long already.

Mr. Frank N. Clark, writing on September 21, 1885, says: "From two pairs of Japanese goldfish, received from the U. S. Fish Commission last winter, Mr. J. D. Yerkes has from 500 to 1,000 little fan-tails hatched this summer."

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

*The Washington Station*.—On account of the unusually low temperature of the water during the spawning season of this fish, which event occurs in May, the spawn was completely destroyed.

The following items are added for the information of persons desiring to cultivate this species:

The golden ide should not be kept in the same pond with carp. The carp make the water muddy and the ides destroy the ova of the carp.



Carp should never be kept in an ide pond if it is desired that such ponds should be clear and that the ides should show to a good advantage.

The golden ide spawns in the neighborhood of Washington in April and the beginning of May, and in cool ponds (spring water) at the end of May. In the Southern States they spawn by the middle of March.

In regard to hatching in ponds, they would do better in large and deep ponds, with a good crowded vegetation, than in small or shallow ponds. The water in such smaller ponds, during cool nights, often attains a low temperature, which would prevent the ova from hatching out advantageously.

The golden ide likes a cool, clear water. Notwithstanding, it can be kept in ponds where the water reaches a higher temperature—from 70° to 80°. In clear, cool water, such as spring water, it will obtain a more brilliant color than in muddy water.

The ide has the habits of a river fish, likes deep better than shallow water. It seeks under plants and stones such food as larvæ, worms, and snails. It takes almost the same food the carp takes, including bread, cooked cornmeal, &c. Green vegetable food it will not take.

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

*The Washington Station.*—The number of tench cultivated in the Washington ponds during the year was as follows: (1) Small pond, 830; (2) north pond, 376; total, 1,206.

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

During the summer of 1885 several shipments were made to Europe of live specimens of this fish. In June 50 were sent to the German Fishery Association, 49 of which arrived safely and were placed in a pond at Berneuchen. In July 100 were shipped to France, 81 of which reached their destination in excellent condition. Thirty were forwarded to the Netherlands, all being received in the best condition. Fifty were sent in June to the National Fish Culture Association of England, 48 of which survived the journey and were at once placed in the tanks of the association, which is striving to acclimatize this food-fish in the waters of Great Britain. Late in 1884 there were sent to Belgium 100 live catfish, 93 of which were reported in January as doing well in the botanical garden at Ghent. These fish were all taken from the Delaware and Schuylkill Rivers, and were sent from New York by Mr. E. G. Blackford. These attempts bid fair to acclimate the catfish in Europe, which at present has only one species of this fish and that of a different type from ours.

w. **The Little Round Clam** (*Tapes staminea*).

*The Wood's Holl Station.*—The sending of Fish Commission car No. 2 to Puget Sound with a car-load of shad furnished the opportunity for bringing back live specimens of several species of mollusks indigenous to that region. The car left Washington on June 2, and Mr. Moore was instructed to secure specimens of *Glycymeris generosa*, *Saxidomus nut-*

*tallii*, *Schizothærus nuttallii*, and *Tapes staminea*. As it was doubtful whether the proper arrangements could be made for carrying the first-named species, experiments were to be confined to the last three. Special instructions for their care were furnished by Prof. R. E. C. Stearns, of the National Museum, whose contributions to the subject have several times appeared in the Fish Commission Bulletin. Mr. Moore was instructed to remain at Puget Sound two or three weeks, if necessary, in order to make such preliminary experiments as would satisfy him that a transcontinental trip could be made successfully. On June 26 Mr. Moore arrived at Wood's Holl with about 500 live *Tapes staminea*, the survivors of about 4,000 with which he started from Tacoma. It is hoped to save enough of them to plant a colony at Wood's Holl and another at Provincetown, Mass.

As illustrative of the facility with which clams may be introduced in localities which have favoring conditions, some facts which were brought to light by Mr. Stearns may be here recited. Mr. Donald Macleay, president of the Board of Trade, Portland, Oreg., forwarded to the National Museum in February of the present year a box of clams for identification. He stated that they were eastern clams found at Shoalwater Bay, Washington Territory, and they proved to be *Mya arenaria*. They had been introduced into Shoalwater Bay by Captain Simpson, a public-spirited citizen of San Francisco, and a member of the firm of Simpson Bros., lumber dealers. Captain Simpson obtained the clams near San Francisco (where this species had previously been introduced and is now abundant), and they were sent on a lumber vessel to Washington Territory, where after their introduction they multiplied extensively and were abundant as early as May, 1884. The *Mya arenaria* being an eastern species the question of course arises how it came on the Pacific coast. To which question Mr. Stearns makes reply that following the completion of the transcontinental railroad, about 1869-'70, some of the oyster firms in San Francisco imported small oysters (*Ostrea virginica*) from the Atlantic Coast and planted them in the bay, where they soon attained a good merchantable size. With these importations of small oysters the spat of *Mya arenaria* undoubtedly was accidentally introduced to the Pacific coast.

#### x. The Oyster (*Ostrea virginica*).

*The Saint Jerome Station.*—This station remained under the superintendence of Mr. Wm. de C. Ravenel during the year, and experiments were continued in collecting the spawn and artificially raising the young oysters. Spawning operations were begun on June 20, and from then until the end of August oysters were opened every day. Young oysters were found twenty-eight days after the first lot of spawn was put into the ponds. The results of the experiments indicate that it is of great importance that the ponds should have the full rise and fall of the tides, which is exceedingly difficult where the water has to be carefully filtered to prevent the passing of spawn. The collectors on which the best re-

sults were obtained were pieces of mortar-coated slate placed in wire trays resting on trestles about 8 inches high. Full details regarding the tides, temperatures, weather, and density of water may be found in the table appended to Mr. Ravenel's report.

*The Cold Spring Harbor Station.*—At this station, which is more particularly under the direction of Mr. E. G. Blackford, representing the New York State Commission, Mr. Mather carried on some very successful experiments. On August 31 he reported that he had used a wooden tank 6 by 12 feet containing water pumped from the harbor for collecting spat and that at that date sets on shells and gravel, four weeks old, were one-eighth of an inch long.

*Investigation in New York waters.*—From the 15th to the 26th of August Mr. E. G. Blackford was engaged in an investigation into the oyster fisheries of New York waters, aided by the steamer Lookout, during which time seven different localities were visited.

The first trip was to the eastern end of Long Island. In the vicinity of Montauk Point the ponds were found to contain but few oysters and these almost without flavor. Near Greenport a plan was in operation in accordance with which oysters were systematically cultivated by individuals and companies, most of the seed being brought from Connecticut. The most serious evil against which the planters had to contend was the starfish. In the kills emptying into New York Bay it was found that much damage was done to the oysters by the acid and oily refuse poured into the waters from the factories along the shores and by the general pollution of the water. The condition of the oysters at Execution Light-house Rock showed a considerable improvement over that of last year, although not much young growth was found. During the trip up the Hudson several dredgings were made on the different beds, generally showing them to be in a fair condition, but frequently showing more or less green coloration. All of the beds of the Hudson are worked for the purpose of obtaining seed with which to plant other beds, as these oysters do not fatten well until transplanted, though many are used for local consumption. In Port Jefferson Harbor much of the bottom is leased and cultivated by private parties, and the beds are generally well cared for and in good condition, the growth not being great but the quality excellent. Most of the seed in the harbor comes from the Connecticut beds, it being generally from one to three years old, and from 200 to 300 bushels per acre being used. Outside the harbor the oysters had been destroyed by starfish or some other enemy. In Prince's Bay and its vicinity oysters were found of good size and in fair number, but usually thin and greenish and sometimes of unpleasant flavor. Much damage is done by the dredgings and the dumping of refuse over or in the neighborhood of the oyster-beds. In the face of such difficulties, the propagation of the oyster, while not to be despaired of, must be a patient and somewhat unpromising matter.

II. **The American Lobster** (*Homarus americanus*).

Attention has already been called in the report of the Commissioner for 1883 to the increasing scarcity of the American lobster and the danger of its practical extinction as an article of commerce within a comparatively short time. Investigations that have been made clearly indicate that the abundance of lobsters, as well as their average size, has been rapidly decreasing from year to year on many portions of the coast where the fishery has been vigorously pushed. A study of their habits shows that such a decrease is far more possible with lobsters than with the true fishes, which are, as a rule, more secure from the attacks of man.

All the States interested in the lobster fishery, except New Jersey, whose fishery is small, have enacted protective laws, but they have failed to stop the diminution, though they may have checked it somewhat. As a result, we are already more or less dependent on the British Provinces for the supplies of our larger markets. The same trouble with the lobster supply exists in Europe, where this fishery has been controlled by legislation for many years. In Norway, which country has the most important European fishery, as a last resort they have sought relief in artificial lobster culture, and experiments in this have been carried on there since 1873. One of the strongest evidences of decrease in the abundance of our lobsters is found in the continual diminution in the size of those sent to the markets, the greater portion of the lobsters now canned being less than 10 inches in length. An investigation shows that there is a steady demand for lobsters of all sizes, and that but a limited protection is afforded by either laws or custom.

The Delaware Breakwater may be regarded as practically the southern limit of the range of the American lobster, though a few specimens have been found south of this; while it was formerly most abundant along the coast of New England, and especially off the coast of Massachusetts, in suitable localities. Maine is now the principal source of supply for all the larger markets of the country, the yearly fishery of that State greatly exceeding in quantity and value those of all the other States combined. Lobsters are not known to migrate, except over very short distances, mainly in the spring and fall, when they change their grounds, moving into deeper water on the approach of cold weather, and returning in late spring nearer to the shore, where the shallower grounds probably furnish a better supply of food.

Lobsters are found during the entire year with spawn attached to the abdomen. This fact is recorded of both the American and the European species, but the length of time this spawn is carried before hatching and the limits of the hatching season are not precisely known. From observations made by fishermen it seems that the eggs hatch in the wells of their smacks in the greatest abundance during May, June, and July, and that the hatching at other seasons is only an accidental or occasional occurrence. It is also not at all improbable that the young hatched during cold weather perish soon after they leave the egg. The

hardy character of the eggs, which appear well adapted to endure the hardships of a long winter, favors the idea of a long period of development.

In the United States the only practical attempts, previous to those of the Fish Commission, towards the artificial propagation of lobsters have been in connection with their "parking," that is, their protection in large inclosed natural basins, in which lobsters that have been injured, soft-shelled individuals, those below salable size, and occasionally females with spawn, have been placed and reared for the markets. Two such parks have been specially called to our attention; one on the coast of Massachusetts, established in 1872 and afterwards abandoned; the other on the coast of Maine, established about 1880, which is believed to be still in operation. The effect of such establishments upon a general increase of supplies would probably never be very great.

*The Wood's Holl Station.*—The partial completion last August of the new laboratory building at Wood's Holl, with its convenient system for the distribution of salt water, permitted the beginning of the needed experiments in the artificial hatching of lobsters. Unfortunately the hatching season had then closed, but it was deemed advisable to ascertain the best methods of handling the eggs in order that there might be as little delay as possible in beginning operations in the spring of 1886. The problem of lobster hatching on a practical scale is one that the Fish Commission has long had in view, but all of its marine laboratories heretofore have been temporary structures with insufficient accommodations and without the means for obtaining continuous supplies of water in suitable quantities. The hatching of small quantities of lobster eggs, as well as the eggs of other kind of crustaceans, had been successfully accomplished by members of the Fish Commission interested in biological studies, and the possibility of doing this on a small scale, and of carrying the young through at least the first few stages of growth, needed no further proof; but the question now is as to doing it on a scale great enough to influence practically the supply of lobsters in our markets.

As the eggs of the lobster have a specific gravity that is considerably greater than that of water, the apparatus selected for the first experiments was the McDonald automatic hatching-jar, and a trial of about two months demonstrated its superiority over the other appliances tested. It does not seem practicable to keep the eggs of more than one lobster in each jar, as the eggs of different individuals vary more or less in specific gravity, and it is impossible to regulate the flow of water so as to give them all the required motion. The number of fertilized eggs carried by a lobster during the spawning season has been ascertained by careful computations in several cases, and varies from 12,000 to 24,000, the number generally being between 15,000 and 18,000; the eggs are comparatively large, measuring about one-twelfth of an inch in diameter.

The chief annoyances to the hatching work at Wood's Holl were iron-rust in the pipes and sediment from the harbor. The difficulty with the iron-rust was overcome to some extent by the substitution of cement-lined pipes, but the eggs were saved from injury by the sediment only by the exercise of constant care. The experiments made so late in the season at Wood's Holl may be regarded as fairly successful, but had they been undertaken during the proper hatching season more satisfactory results would undoubtedly have been reached. The principal object in hatching the eggs in jars is to have the embryos under control immediately after hatching; but the best methods of caring for the young have yet to be decided upon, and present an interesting problem for future investigation. It is not known how long the young can be kept in confinement, nor at what age it would be advisable to turn them over to the care of nature, but it will probably be possible to transport them alive to any other portion of the New England coast.

*Summary of distribution of fish and eggs by the U. S. Fish Commission during the season of 1885.*

Whitefish ( <i>Coregonus clupeiformis</i> ):	
Eggs .....	*42,800,000
Fry .....	†92,000,000
Brook trout ( <i>Salvelinus fontinalis</i> ):	
Eggs .....	*145,000
Fry .....	**25,000
Large fish .....	*550
Lake trout ( <i>Salvelinus namaycush</i> ):	
Eggs .....	*1,031,000
Fry .....	*75,500
Large fish .....	**1,791
Rainbow trout ( <i>Salmo irideus</i> ):	
Eggs .....	††281,000
Fry .....	**250
Large fish .....	††4,664
Atlantic salmon ( <i>Salmo salar</i> ):	
Eggs .....	§1,251,500
Fry .....	419,550
Landlocked salmon ( <i>Salmo salar</i> subsp. <i>sebago</i> ):	
Eggs .....	†222,000
Fry .....	§§41,500
Brown trout ( <i>Salmo fario</i> ):	
Fry .....	28,900

\* From Northville Station.

† From Northville and Alpena Stations.

‡ From Grand Lake Stream Station.

§ From Bucksport Station.

|| From Cold Spring Harbor Station.

\*\* From Wytheville Station.

†† Of these 5,000 were from Northville Station, 246,000 from McCloud River Station, and 30,000 from Wytheville Station.

‡‡ Of these 3,364 were from Northville Station, and 1,300 from Wytheville Station.

§§ Of these 22,000 were from Northville Station, and 19,500 from Cold Spring Harbor Station.

Shad ( <i>Clupea sapidissima</i> ):	
Eggs .....	*325, 000
Fry .....	†34, 659, 000
Carp ( <i>Cyprinus carpio</i> ):	
Fry to public waters .....	*161, 370
Fry to private ponds .....	*187, 414
Goldfish ( <i>Carassius auratus</i> ) .....	*4, 344
Black bass ( <i>Micropterus dolomieu</i> ) .....	‡500
Red-eye perch ( <i>Ambloplites rupestris</i> ) .....	‡250
Total .....	173, 666, 083

## D.—ABSTRACT OF THE ARTICLES IN THE APPENDIX.

### 32.—CLASSIFICATION OF ARTICLES.

In the general appendix to this report will be found a series of twenty-five 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 full account of the work of the steamer Albatross during 1885 in the Gulf of Mexico, on the Newfoundland fishing banks, and along the coast, illustrated by five plates and provided with a special index. In this report are also included subordinate reports by Lieut. Seaton Schroeder on navigation, Passed Assistant Engineer G. W. Baird on all matters pertaining to the machinery of the vessel, Surgeon James M. Flint on the medical department, Mr. James E. Benedict on the scientific work of the naturalists, and also various tables of temperatures, specific gravities, stations occupied, records of dredgings and trawlings, and lists of fishes, invertebrates, &c., taken. The second report is by Lieut. L. W. Piepmeyer on the work of the Fish Hawk during the year 1885, followed by a report on the operations of the Lookout during the year, by Mate James A. Smith. The ten papers which follow relate chiefly to the hatching and propagating operations of the Fish Commission, and are composed of reports from the persons charged with the work of propagation, distribution, or investigation. They consist of a report of the operations of the trout-breeding station at Wytheville, Va., from its occupation in January, 1882, to the close of 1884, by Col. Marshall McDonald; two reports of fish hatching and shipments, and an account of eggs shipped to and received from foreign countries during 1885 and a part of 1886, at the Cold Spring Harbor Station, by Mr. Fred Mather; the operations at the Northville and Alpena Stations during the season

\* From Central Station.

† Of these 15,531,000 were from Central Station, 10,725,000 from Battery Station, 8,063,000 from steamer Fish Hawk, and 340,000 from steamer Lookout.

‡ From Wytheville Station.

of 1885-'86, by Mr. Frank N. Clark; the operations at the United States salmon and trout stations on the McCloud River, in California, for 1885, by Mr. Livingston Stone; two reports on the work in Maine (on the propagation of Penobscot salmon and Schoodic salmon) by Mr. Charles G. Atkins; a report on an oyster investigation in New York waters with the steamer Lookout, by Mr. Eugene G. Blackford, one of the fish commissioners of New York; the operations at the Saint Jerome oyster-breeding station, by Mr. William deC. Ravenel; and a report on the thermometers of the U. S. Fish Commission, by Dr. J. H. Kidder.

#### B.—THE FISHERIES.

The four articles in this section are of a more general nature, three of them pertaining to the fishing industries of European countries. The first is a report by Capt. Joseph W. Collins on the discovery and investigation of the fishing-grounds visited by the steamer Albatross during a cruise along the Atlantic coast and in the Gulf of Mexico, with notes on the Gulf fisheries, having special reference to the fisheries off the west coast of Florida. This is illustrated by ten plates, and has a special index. A paper follows containing extracts from the Norwegian fishery statistics for 1884, by Boye Strom. The next article is a translation from the Norwegian Fishery Gazette on the manufacture of klipfish, which treats of the salting and drying of codfish in general, but with more particular reference to the process as carried on in Norway. The last paper is an extract from the report of G. Bouchon-Brandely, the French minister of marine and the colonies, on pearls and mother-of-pearl at Tahiti and the Tuamotu Archipelago, which gives a very good idea of this new and growing industry in the South Pacific.

#### C.—OYSTER CULTURE.

The one article in this section it is hoped will prove of remarkably practical value, in that it contains an exposition of the principles of a rational system of oyster culture, together with an account of a new and practical method of obtaining oyster spat on a scale of commercial importance. It is by Prof. John A. Ryder, is illustrated by four plates, and is provided with a special index.

#### D.—SCIENTIFIC INVESTIGATION.

Of the five papers in this section, the first is a report by Sidney I. Smith on the decapod crustacea of the Albatross dredgings off the east coast of the United States during the summer and autumn of 1884, illustrated by twenty plates and having a special index. The next is an article by John A. Ryder on the development of the cetacea, together with a consideration of the probable homologies of the flukes of cetaceans and sirenians. This is furnished with three plates, and has also an index of its own. The following article is also by Mr. Ryder, on the development of osseous fishes, including marine and fresh-water forms,



which is illustrated by thirty plates. The next paper is by Prof. H. E. Webster and James E. Benedict, on the Annelida Chætopoda, from Eastport, Me., which has eight plates and is provided with a special index. The last paper is by John Murray and A. Renard on the nomenclature, origin, and distribution of deep-sea deposits, which was read before the royal society of Edinburgh.

E.—MISCELLANEOUS.

The first of the two articles in this section is a catalogue of the fishes known to inhabit the waters of North America north of the Tropic of Cancer, with notes on the species discovered in 1883 and 1884, by Prof. David S. Jordan, which is provided with a valuable special index of forty-three pages. The last article of the appendix is by Robert G. Dyrenforth, giving a list and description of the patents issued by the United States during the years 1882, 1883, and 1884, which relate to fish and the methods, products, and applications of the fisheries, the article being illustrated by one hundred and fifty pages of plates.

This series of twenty-five papers contains many of high value, and is illustrated by two hundred and thirty plates. Seven of the longer 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.

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

The following is a list of the light-houses (with their keepers) at which temperatures and the 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 1885, 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. Levitt, box 808, 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. (Thomas V. Mullins reported October, November, and December) . . . . .	12
Pollock Rip light-station, entrance to Vineyard Sound.	
Joseph Allen, jr., South Yarmouth, Mass. . . . .	12

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Nantucket New South Shoal light-station, Davis New South Shoal. Andrew J. Sandsbury, Nantucket, Mass .....	12
Cross Rip light-station, Vineyard Sound. Luther Eldridge, Chatham, Maas .....	11
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 .....	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, N. Y. (Ezra S. Mott reported September, October, November, and December) .....	12
Fire Island light-house, south side of Long Island. Seth R. Hubbard, Bay Shore, N. Y .....	11
Sandy Hook light-house, entrance to New York Bay. E. 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 .....	8
Winter-Quarter Shoal light-station, Chincoteague Island, Va. C. Lindemann, 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. 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 .....	12
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. 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
Fowey Rocks light-house, Fowey Rocks. John J. Lerner, Miami, Fla .....	12
Carysfort Reef light-house, Florida Reefs. Martin Weatherford, Key West, Fla .....	12
Dry Tortugas light-house, Loggerhead Key. Robert H. Thompson, Key West, Fla .....	12

## 34.—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. For many thousands of miles the service has been conducted without any cost whatever to the Commission. The only road that charged more than 20 cents per mile is the Union Pacific.

*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 1885.*

	Miles.
Alabama Great Southern Railroad; Chattanooga, Tenn .....	143
Boston and Albany Railroad; Springfield, Mass.....	800
Central Railroad of Georgia; Savannah, Ga.....	690
Charlotte, Columbia and Augusta Railroad; Columbia, S. C.....	489
Chesapeake and Ohio Railway; Richmond, Va.....	1,032
Chesapeake, Ohio and Southwestern Railway; Louisville, Ky.....	392
Chicago, Burlington and Quincy Railroad; Chicago, Ill.....	374
Chicago, Milwaukee and Saint Paul Railway; Milwaukee, Wis.....	1,220
Chicago and Northwestern Railway; Chicago, Ill.....	580
Chicago, Saint Louis and Pittsburg Railroad; Pittsburg, Pa.....	381
Columbia and Greenville Railroad; Columbia, S. C.....	107
Cumberland Valley Railroad; Chambersburg, Pa.....	222
Delaware, Lackawanna and Western Railroad; New York, N. Y.....	154
East Tennessee, Virginia and Georgia Railroad; Knoxville, Tenn.....	242
Georgia Railroad; Augusta, Ga.....	171
Illinois Central Railroad; Chicago, Ill.....	1,756
Indianapolis, Decatur and Springfield Railway; Indianapolis, Ind.....	153
Louisville and Nashville Railroad; Louisville, Ky.....	127
New York Central and Hudson River Railroad; New York, N. Y.....	298
New York, New Haven and Hartford Railroad; New York, N. Y.....	240
New York, Providence and Boston Railroad; Stonington, Conn.....	128
New York, West Shore and Buffalo Railway; New York, N. Y.....	705
Norfolk and Western Railroad; Philadelphia, Pa.....	727
Ohio and Mississippi Railway; Cincinnati, Ohio.....	43
Pennsylvania Railroad; Philadelphia, Pa.....	15,329
Pittsburg, Cincinnati and Saint Louis Railway; Pittsburg, Pa.....	5,715
Richmond and Danville Railroad; Richmond, Va.....	2,628
Richmond, Fredericksburg and Potomac Railroad; Richmond, Va.....	40
Saint Louis, Keokuk and Northwestern Railway; Keokuk, Iowa.....	262
Savannah, Florida and Western Railway; Savannah, Ga.....	666
Shenandoah Valley Railroad; Philadelphia, Pa.....	909
Terre Haute and Indianapolis Railroad; Terre Haute, Ind.....	3,334
Union Pacific Railway; Omaha, Nebr.....	2,603
Virginia Midland Railway; Alexandria, Va.....	4,506
Wabash, Saint Louis and Pacific Railway; Saint Louis, Mo.....	902
Western Railway of Alabama, and Atlanta and West Point Railroad; Montgomery, Ala.....	525
<b>Total.....</b>	<b>48,593</b>

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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 sixteen roads. The aggregate number of miles of free transportation received was 26,212.

List of railroads that moved cars, and messengers to the number of five accompanying, free of charge during the year 1885.

	Miles.
Atchison, Topeka and Santa Fé Railroad; Topeka, Kans .....	4, 134
Atlantic and Pacific Railroad; Albuquerque, N. Mex .....	1, 952
Chicago and West Michigan Railway; Muskegon, Mich .....	54
Detroit, Grand Haven and Milwaukee Railway; Detroit, Mich .....	288
Flint and Pere Marquette Railroad; East Saginaw, Mich .....	1, 972
International and Great Northern Railroad; Saint Louis, Mo .....	932
Lake Shore and Michigan Southern Railway; Cleveland, Ohio .....	98
Michigan Central Railroad; Detroit, Mich .....	1, 892
Milwaukee, Lake Shore and Western Railway; Milwaukee, Wis .....	106
Missouri, Kansas and Texas Railway; Saint Louis, Mo .....	1, 252
Missouri Pacific Railway; Saint Louis, Mo .....	2, 034
Northern Pacific Railroad; Saint Paul, Minn .....	7, 498
Oregon Railway and Navigation Company; Portland, Oreg .....	916
Saint Louis, Iron Mountain and Southern Railway; Saint Louis, Mo .....	490
Texas and Pacific Railway, Dallas, Tex .....	2, 064
Utah Central Railway; Salt Lake City, Utah .....	530
<b>Total .....</b>	<b>26, 212</b>

35.—SUMMARY OF FISH DISTRIBUTED TO PUBLIC WATERS FROM 1872 TO 1882, INCLUSIVE, BY THE U. S. FISH COMMISSION.

The following table shows a total of 341,096,971 fish distributed to public waters during the first 11 years of the existence of the Commission:

Waters stocked.	Atlantic salmon.	California salmon.	Landlocked salmon.	Salmon trout.	California trout.
From Saint John River to Merrimac River, inclusive .....	5, 851, 139	754, 700	2, 849, 412		2, 000
Massachusetts Bay to Cape Cod Bay, inclusive .....	45, 000	138, 000	448, 100		
Buzzard's Bay to Block Island Sound, inclusive .....	704, 597	363, 000	324, 100		
Connecticut River and tributaries .....	1, 879, 086	740, 000	724, 861		
Long Island Sound, exclusive of Connecticut River .....	363, 937	410, 186	501, 049		
Hudson River and tributaries .....	568, 300	193, 500	43, 250		
From Hackensack River to Sandy Hook Bay, inclusive .....	111, 000	188, 000	48, 150		
From Sandy Hook Point to Cape May, inclusive .....		119, 000			
Delaware Bay .....	906, 822	1, 054, 829	178, 819	2, 000	
From Cape Henlopen to Cape Charles .....		13, 000			
Chesapeake Bay .....	463, 796	5, 041, 544	178, 175		88, 000
Albemarle Sound .....		176, 000	6, 450		
Pamlico Sound .....		10, 200	600		
From Cape Fear River to Altamaha River, inclusive .....	11, 000	1, 015, 500	28, 525	35, 000	4, 000
Gulf of Mexico east of the Mississippi River .....		89, 500			
Mississippi River and tributaries .....	2, 102, 100	5, 835, 760	444, 650	3, 600	22, 000
Gulf of Mexico west of the Mississippi River .....		92, 000			
Pacific coast .....		13, 183, 000	33, 647		
Great Lakes and Saint Lawrence River .....	987, 100	1, 955, 315	37, 510		89, 102
Miscellaneous .....	265, 950	599, 300	217, 703		11, 728
<b>Total .....</b>	<b>12, 519, 887</b>	<b>33, 172, 734</b>	<b>6, 404, 961</b>	<b>40, 600</b>	<b>116, 830</b>

Waters stocked.	Brook trout.	Shad.	Whitedsh.	Herring.	Miscellaneous.
From Saint John River to Merrimac River, inclusive		3,123,500	775,000		10,000 <i>Salmo salar</i> × <i>S. salar</i> var. <i>sebago</i> .
Massachusetts Bay to Cape Cod Bay, inclusive		800,000			
Buzzard's Bay to Block Island Sound, inclusive		2,172,000			
Connecticut River and tributaries		9,661,000	75,000		
Long Island Sound, exclusive of Connecticut River		180,000	7,000		
Hudson River and tributaries		1,133,000	45,000		
From Hackensack River to Sandy Hook Bay, inclusive			90,000		
From Sandy Hook Point to Cape May, inclusive					
Delaware Bay		1,538,000	45,000		
From Cape Henlopen to Cape Charles		50,000			4,500 Rhine salmon.
Chesapeake Bay	27,200	134,032,850		7,833,000	25,000 codfish, 270,000 Spanish mackerel, 5,000 Rangley trout, and 180,000 white perch.
Albemarle Sound		8,778,900			400,000 rockfish.
Pamlico Sound		1,300,000			
From Cape Fear River to Altamaha River, inclusive		7,997,100			
Gulf of Mexico east of the Mississippi River		5,628,000			
Mississippi River and tributaries	41,000	18,788,400	575,000		7,500 Rangley trout.
Gulf of Mexico west of the Mississippi River		2,469,000		2,000,000	
Pacific coast		610,000	510,000		
Great Lakes and Saint Lawrence River	20,000	8,160,400	72,785,000		409 moranke.
Miscellaneous		5,200	2,165,000		
Total	88,200	200,946,350	77,072,000	9,833,000	802,409

36.—CIRCULAR TO PERSONS ENGAGED IN THE COD, HALIBUT, AND OTHER GROUND FISHERIES.

The following circular was widely distributed to fishermen and owners of vessels during November, 1885:

UNITED STATES COMMISSION OF FISH AND FISHERIES,  
Washington, D. C., November 1, 1885.

The temporary arrangement made between the Governments of the United States and of Canada, providing for the continuance, in a modified form, of the present international fisheries treaty, makes accurate information in regard to the fisheries of 1885 of very great importance. All persons interested are therefore earnestly requested to render their aid in having ready the necessary data for any future international action. With this object the accompanying blank has been prepared, and will be distributed through Mr. W. A. Wilcox, assistant to the United States Fish Commission, at Gloucester, Mass., from whom any number of copies can be obtained. Any information, when so requested, will be considered strictly confidential, but will be collated in the digest to be made at the close of the fishing season.

The complete record of your port should be sent to Mr. Wilcox immediately.

Any matters of record, prices, &c., not covered by the questions, will add to the value of the return.

SPENCER F. BAIRD,  
U. S. Commissioner of Fish and Fisheries.

[Blanks when filled, and other information on the subject, should be sent to W. A. Wilcox, United States Fish Commission, Gloucester, Mass.]

COD, HALIBUT, AND OTHER GROUND FISH.

Port of \_\_\_\_\_, \_\_\_\_\_ Season of 1885.

	No. of vessels.	Tonnage.	Codfish. Pounds.	Halibut. Pounds.	Other ground fish. Pounds.
Number of vessels that fished on Banquereau, Flemish Cap, Grand, La Have, and Western Banks					
Number of vessels that fished on George's and Brown's Banks					
Number of vessels that fished off Nova Scotia shore					
Number of vessels that fished off Greenland and Iceland					
Number of vessels that fished in the Gulf of St. Lawrence					
Number of vessels that fished off New England shore					
Number of vessels, unregistered, that fished off New England shore					
Number of small boats, unregistered, that fished off New England shore					

As some of the above fished on the several grounds, please give total number of registered vessels and tonnage in cod and ground fishing, \_\_\_\_\_.

Total number of men fishing on vessels and in boats, \_\_\_\_\_.

Total amount of halibut caught within three miles of provincial shore, and where taken, \_\_\_\_\_.

Total amount of cod and other ground fish caught within three miles of provincial shore, and where taken, \_\_\_\_\_.

Kind of bait used, \_\_\_\_\_.

Quantity and amount paid for bait in the provinces, \_\_\_\_\_.

Quantity and amount paid for bait in the United States, \_\_\_\_\_.

Quantity and amount paid for ice in the United States, \_\_\_\_\_.

Quantity and amount paid for ice in the provinces, \_\_\_\_\_.

Amount paid for supplies purchased in the provinces, \_\_\_\_\_.

Amount paid for other expenses in the provinces, with items, \_\_\_\_\_.

Total value of fishing vessels and boats from your port, \_\_\_\_\_.

Total value of outfits on vessels from your port, \_\_\_\_\_.

Number of new vessels for above fishing past year, \_\_\_\_\_; and tonnage, \_\_\_\_\_.

Number of vessels for above fishing lost past year, \_\_\_\_\_.

Number of lives for above fishing lost past year, \_\_\_\_\_.

Insurance on vessels lost for above fishing past year, \_\_\_\_\_.

It is important that this should be filled up as near as possible, and returned at once. Do not lay it aside, but please give it your immediate attention. Any answer or information requiring more space please mention on opposite page.

(Signed)