REPORT OF THE COMMISSIONER.

A.—GENERAL CONSIDERATIONS.

1.—INTRODUCTORY REMARKS.

The present volume (for 1883) constitutes the eleventh of the series of annual reports of the work of the United States Fish Commission as ordered by Congress, and is intended to give an account of the proceedings of the Commission in its various divisions.

With the completion of the buildings at Wood's Holl the Commission hopes to be ready to carry out, on such scale as may be authorized by Congress, the various functions intrusted to it.

With the acquisition, with the means provided by Congress, of steamers capable of carrying on work in the ocean, as well as in the interior waters, the possibilities of usefulness have become greatly extended, and much has been attempted as well as accomplished. In addition to the regular work of the Commission, it has become possible to do a great deal for the advancement of science in general, especially by prosecuting researches into the general natural history of the aquatic animals and plants, either by persons officially connected with the Commission or by specialists to whom the facilities of the service are extended in the way of the use of boats, stations, and material.

The Commission has also made very large collections of aquatic animals, especially of fishes, shells, corals, crustaceans, starfishes, &c., and after submitting them to a careful investigation for monographic research, and setting aside a full series for the National Museum, the remainder has been made up into well-identified and labeled sets for distribution to colleges, academies, and other institutions of learning throughout the United States. The educational advantages of this last measure have proved to be of the utmost value, and are thoroughly appreciated by teachers throughout the country. Applications for these sets are being continually received, and several hundreds of them have already been supplied, a number of persons being occupied for a good part of their time in preparing to meet additional calls. There is nothing that so much increases the interest in natural history as the opportunity of examining actual specimens of rare and usually unprocurable species, instead of depending upon descriptions or drawings; and as the possibility of obtaining these series becomes the better known,

it is quite likely that all the resources of the Commission for making collections, great as they are, will be fully taxed.

The calls for these specimens are usually made through the member of Congress representing the district in which the institution is established; or if made directly to the Commission, they are referred to the member for his indorsement and recommendation.

Some noteworthy features of the year 1883 were as follows:

1. The completion of the Albatross and her arrival in Washington, March 24, fully equipped for service.

2. The use of the Albatross in studying the movements of schools of menhaden, mackerel, and other ocean fishes.

3. The use of the electric light by the Albatross in submarine explorations.

4. A request from prominent men of Great Britain connected with the International Fisheries Exhibition for an exhibit of the Albatross.

5. The loan of the Albatross, in compliance with a request of the Navy Department, for a cruise in the Caribbean Sea, the arrrangements for which were completed during the year, although the cruise did not commence until January 4, 1884.

6. The employment of the Fish Hawk in hatching Spanish mackerel in the Chesapeake Bay.

7. The stranding of the Fish Hawk on Ocean Beach on the night of July 13, and her recovery, without serious damage, on July 18.

8. The transfer of land at Wood's Holl, on April 20, from trustees (representing the subscribers who furnished the purchase-money) to the United States, and the beginnings of the erection of building thereon.

9. The commencement and vigorous prosecution of work on the pier and breakwater at Wood's Holl, for which money was appropriated by Congress the preceding year.

10. The opening of the Great International Exhibition at London, May 1, and its closing on October 31, during which time a large exhibit was made by the U. S. Fish Commission, which attracted universal attention.

11. The continuance of the investigation of the ocean fisheries by a special committee of the United States Senate (Hon. E. G. Lapham, chairman), with the co-operation of the U. S. Commission, represented by Mr. Marshall McDonald, and including the use of the Fish Commission steamer Lookout.

12. The perfecting of an arrangement with the Life-Saving and Light-House Services whereby the keepers for the entire coast make telegraphic reports to the Commission of the stranded whales, porpoises, and other forms of marine life.

13. The hearty co-operation of certain railroad corporations in the work of distributing shad, carp, whitefish, &c., by transporting the Fish Commission cars free of charge. Notably among these were the Northern Pacific, which moved a car loaded with carp from Saint Paul to Portland, Oreg.; the Missouri Pacific, and the Atchison, Topeka and

Santa Fé, which carried a car from Saint Louis through Arkansas and Texas and back; the Flint and Père Marquette, which furnished many free trips for the cars containing whitefish; the Utah Central and various other companies.

14. The selection of a plan for a suitable fishway to be erected at the Great Falls of the Potomac, and the accomplishment of the preliminary surveys therefor.

15. The laying out of extensive experimental oyster-ponds at Saint Jerome Creek, Md.

16. The success of Mr. John A. Ryder in the artificial propagation of oysters at Stockton, Md.

17. The completion of an apron and other improvements at the Havre de Grace station.

18. The opening of the Cold Spring Harbor station by the New York State commission, and its use by the U. S. Commission.

19. The survey of the Columbia River and certain tributaries by Mr. Livingston Stone, with the view to finding suitable localities for salmon hatcheries.

20. The suspension of work at the McCloud River salmon station, the run of salmon having been seriously intermitted by the blasting necessary to the erection of the Northern Pacific Railroad along the river.

21. The increased production of whitefish at Northville and Alpena, Mich., fully 100,000,000 eggs having been taken.

22. The introduction of whitefish into Eagle Lake, Mount Desert Island, Maine.

23. The concerted action of the State fish commissions directly interested in the fisheries of the Great Lakes and the protection of those fisheries.

24. The occupation of Fort Washington, on the Potomac, for shad-hatching, permission having been granted by the Secretary of War.

25. The application of the method of transferring eggs of the shad to a distance, in a moist condition, on trays, it having heretofore been necessary to hatch the eggs at the stations and make the transfer of live fish to a distance.

26. Large run of shad in the Sacramento River, California, resulting from the introduction of young in these waters a few years since by the Fish Commission.

27. The great increase in productiveness of the inshore cod-fisheries, due to the general use of cod gill-nets which were introduced by the U. S. Commission.

28. The reappearance in Gloucester Harbor and at some other points of young cod, believed to belong to a school hatched at Gloucester in 1878.

29. Efforts to hatch cod in New York from eggs taken at Fulton Market.

30. The continued activity in the work of propagation and distribution of German carp.

31. The successful importation from Germany of the blue carp.

32. The discoveries by a Fish Commission agent, Mr. James G. Swan, in regard to the possibilities of an extended fishery on the Pacific coast for the black cod, and its indorsement by New York and Boston experts as a valuable food-fish.

33. The experiments of Mr. S. G. Worth in taking and hatching eggs of striped bass, or rockfish, which give promise of very valuable results hereafter.

A brief memorandum of what the U. S. Fish Commission hopes to accomplish in time, in connection with its mission, is as follows:

1. In the department of investigation and research there is yet to be carried out an exhaustive inquiry into the character, abundance, geographical distribution, and economical qualities of the inhabitants of the waters, both fresh and salt. The subject is practically unlimited in extent, and, so far as the ocean is concerned, has scarcely been touched. With the powerful apparatus, however, at the command of the Commission it is expected that much progress will be made year by year, and that the publication of the results and the distribution of duplicate specimens to colleges and academies in the United States will be carried out on a large scale, so as to meet a large and increasing demand from teachers and students.

2. A second object, in connection with the sea fisheries, is the improvement of the old methods and apparatus of fishing and the introduction of new ones.

The work of the Commission in bringing to the notice of American fishermen the importance of gill-nets with glass-ball floats for the capture of codfish has already revolutionized the winter cod-fishery industry in New England. Looked upon almost with ridicule by the Gloucester fishermen, when first brought to their notice by the Commission, these nets have come rapidly into use, until at the present time they represent the most important element in the winter fisheries, the number of fish taken being not only much greater than heretofore but the fish themselves of finer quality.

The ability to maintain a successful fishery without the use of bait is of the utmost importance, in view of the fact that when cod are most abundant bait is almost unprocurable. Other forms of apparatus of less importance have also been introduced, and a constant lookout is maintained, by correspondence and otherwise, in connection with the improvement of fishing machinery.

3. Another important point for consideration is that of improvement in the pattern of fishing vessels. There is annually a terrible mortality in the fishing crews of New England, especially those belonging to the port of Gloucester, to say nothing of the total loss and wreck of the fishing vessels and their contents. There has gradually developed in connection with the mackerel and cod fisheries of New England a pattern of vessel which, while admirable for speed and beauty of lines

and of rig, is less safe under certain emergencies than the more substantial and deeper vessel used abroad, especially in England and Scotland.

The subject of the best form of fishing-vessel has been intrusted to Captain Collins, of the Commission, himself a most experienced fisherman, and, after a careful study of the boats of all nations, he has prepared a model which is believed to combine the excellencies of both English and American vessels.

An appropriation will be asked from Congress for means to construct an experimental vessel and test its qualities; but until a successful experiment has been made it will be difficult to induce the fishermen to change their present form of construction.

4. The fourth object of the Commission is to determine the extent and general character of the old fishing localities and to discover new ones. There is no doubt whatever that there still remain many important areas, even in the best-known seas, where the codfish and halibut will be found in their former abundance. There has never been any formal investigation on this subject, and the banks that are known have been brought to light purely by accident. It is believed that by a systematic research and a careful survey the area of known grounds can be greatly extended.

There is very great reason to hope for successful results from this inquiry in the waters off the South Atlantic coast and in the Gulf of Mexico. These regions, the latter especially, may be considered as practically unknown, the few established localities for good fishing being in very small proportion to what must exist. It is here that the service of the fishing schooner referred to above, if means can be obtained to build it, will be brought into play, and it is not too much to hope that an industry will be developed that will represent to the Southern and Southwestern States the same source of income and occupation that the mackerel, cod, and halibut furnish to the fishermen of New England.

5. There is also much to be learned in the way of curing and packing fish for general and special markets. The American methods have grown up as a matter of routine, and are adapted to only one class of demand. There are, however, many modes of preparation which can be made use of to meet the wants of new markets; and thus we can enter more efficiently into competition with European nations for European trade, as well as for that of the West Indies and South America.

A great advance has already been made toward this desired improvement since the Centennial Exhibition of 1876, where many methods of curing and putting up fish were shown in the foreign sections that were almost entirely unknown in America. Notable among these were the preparations of sardines and other species of herring in oil, as well as in spiced juices. Quite recently this industry has been well established in Maine, amounting to a value of millions of dollars, and there are many other parts of the country where the same work can be done with other kinds of fish. The whole subject is receiving the careful consideration of the Commission, and numerous facts bearing upon it have been announced in its reports and bulletins.

6. The work of increasing the supply of valuable fishes and other aquatic forms in the waters of the United States, whether by artificial propagation or by transplantation, although very successful, may be considered as yet in its infancy.

It must be remembered that the agencies which have tended to diminish the abundance of the fish have been at work for many years and are increasing in an enormous ratio. This, taken in connection with the rapid multiplication of the population of the United States, makes the work an extremely difficult one. If the general conditions remained the same as they were fifty years ago, it would be a very simple thing to restore the former equilibrium.

At that time, it must be remembered, the methods of preservation and of wholesale transfer, by means of ice, were not known, while the means of quick transportation were very limited. Hence a small number of fish supplied fully the demand, with the exception, of course, of species that were salted down, like the cod, the mackerel, and the herring (including the shad). Now, however, the conditions are entirely changed. The whole country participates in the benefits of a large capture of fish, and there is no danger of glutting the market, since any surplus can be immediately frozen and shipped to a distance or held until the occurrence of a renewed demand.

Another impediment to the rapid accomplishment of the desired result is the absence of concurrent protective legislation of a sufficiently stringent character to prevent unnecessary waste of the fish during the critical period of spawning, and the erection or maintenance of impediments to their movements in reaching the spawning grounds. This is especially the case with the shad and the salmon, where the simple construction of an impassable dam, or the erection of a factory discharging its poisonous waste into the water, may in a few years entirely exterminate a successful and valuable fishery.

It is to be hoped that public opinion will be gradually led up to the necessity of action of the kind referred to, and that year by year a continued increase in the fisheries will be manifested. Even if this does not occur as rapidily as some may hope, the experiments so far furnish the strongest arguments in favor of continuing the work for a reasonable time. A diminution that has been going on for fifty or more years is not to be overcome in ten, in view of the increasing obstacles already referred to.

Among the species, an increase of which in their appropriate places and seasons is to be hoped for, in addition to those now occupying the attention of fish-culturists, are the cod, the halibut, the common mackerel, the Spanish mackerel, the striped bass, or rockfish, &c.

One of the most important, and at the same time among the most promising, fish is the California trout, with which it is hoped to stock large areas of the country. Its special commendations will be found mentioned elsewhere.

Another fishery earnestly calling for assistance, and capable of re-

ceiving it, is that of the lobster, the decrease of which has been very marked. The experiments of the Fish Commission suggest methods by which the number can be greatly increased. Something, too, may be done with the common crab of the Atlantic coast and its transfer to the Pacific. Some kinds might also be advantageously brought to the eastern portion of the United States from the Pacific coast and from the European seas.

A subject of as much importance as any other that now occupies the attention of the Fish Commission is an increase in the supply of oysters. In no department of the American fisheries has there been so rapid and alarming a decrease, and the boasted abundance of this mollusk on the Atlantic coast, especially in Chesapeake Bay, is rapidly being changed to a condition of scarcity which threatens practical extermination, as is almost the case in England. A fishing industry producing millions of dollars is menaced with extinction, and needs the most stringent measures for its protection.

The U. S. Fish Commission has been very fortunate, through its agents and assistants, in making important discoveries in connection with the propagation of the oyster, which are to be referred to hereafter; and it is proposed to establish several experimental stations for applying the discoveries thus made, so as to constitute a school of instruction and information to persons practically engaged in the business.

There are other shell-fish besides the oyster that will well repay the trouble of transplantation and multiplication. Among these are several species of clams belonging to the Pacific coast of the United States, which are much superior in size, in tenderness, and in excellence of flavor to those on the eastern coast. Most of these are natives of Puget Sound, and the completion of the Northern Pacific Railway is looked forward to as a convenient means of transferring them to Eastern waters. The common clams of the Atlantic coast are also fair subjects of experiment.

As might be expected, the correspondence of the Commission presents the usual increase in magnitude; requiring, of course, increased service in briefing, registering, filing, &c.*

**Table showing the number of letters received and written and the number of fish applications received by the U. S. Fish Commission during the fiscal year ending June 30, 1883.*

Months.	Letters registered.		Fish applications registered.	Total of letters and applications.
	Received.	Written.		
1882.				
July	696	547	264	1,507
August	397	534	74	1,005
September	325	588	405	1,318
October	1,656	692	1,093	3,441
November	1,557	721	692	2,970
December	1,355	930	1,380	3,665
1883.				
January	1,501	1,121	905	3,527
February	1,514	1,050	774	3,338
March	1,620	1,073	859	3,552
April	1,572	1,046	784	3,402
May	1,102	786	199	2,087
June	1,057	828	505	2,390
Total	14,352	9,916	7,934	32,202

The Commission lost, by the death of Mr. Frank S. Eastman on March 12, an accomplished engineer and draughtsman, to whom it owed very much in connection with the planning and building of its fish-transportation cars.

Although not at the time an employee of the Commission, but as having formerly been in its service, it is proper to mention the death of Mr. O. M. Chase, on November 11. Mr. Chase, at the time of his death, was superintendent of the fish hatchery of the State of Michigan, at Detroit, and was engaged in collecting eggs of whitefish. Mr. Chase and a party of his employees, while crossing a bay in a small boat during a violent storm, were drowned by the upsetting of the boat. He was one of the most experienced fish-culturists of the country, having been trained by Mr. Seth Green, and having been in his employ, and also in that of the Fish Commission, before entering the service in which he met his death.

The three-story building No. 1443 Massachusetts avenue, which was leased in 1881, has continued to be occupied as an office by the Commission. The commissioner has, however, continued to use for himself and stenographer certain rooms in his private residence.

2.—PRINCIPAL STATIONS OF THE U. S. FISH COMMISSION.

These stations have been mentioned in previous reports, and a full explanation given of their general character. There are therefore simply enumerated in the present report to serve as a convenient table of reference. The special work accomplished at each station for the year will be given hereafter.

A.—Investigation and Research.

1. *Gloucester, Mass.*—Capt. S. J. Martin, in charge of this station, continues his weekly reports of the products of the off-shore fisheries of that city, which have been collated and published from time to time in the Bulletins of the Fish Commission.

Captain Martin visits every vessel on its arrival and obtains the statistics of the catch during the voyage; and as there is no other organization for obtaining these data, his figures are largely used in the market reports of the Boston and Gloucester papers.

2. *Wood's Holl, Mass.*—This continues to be the headquarters of the Commission during the summer, and the chief locality for investigation and research. It is also the summer station of the vessels of the Commission.

The arrangements made for enlarging the work at this point will be more fully detailed hereafter.

3. *Saint Jerome, Md.*—This station is maintained for experiments in oyster culture and the hatching of marine fish, especially of the Spanish mackerel.

B.—PROPAGATION OF SALMONIDÆ.

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

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

6. *Northville, Mich.*—This establishment is principally concerned in the hatching of whitefish, which are collected by Mr. F. W. Clark and his assistants, and at the proper time are either forwarded, in the condition of embryonization, to distant points, or entirely hatched out and the minnows transmitted to suitable localities. The station is also used for breeding the Eastern brook-trout and the California trout, of which a good stock is maintained. Two new trout ponds were completed in June.

7. *Alpena, Mich.*—This station was established in 1882 for the whitefish service, as being conveniently near the best localities for taking the eggs. It is kept as a feeder to the Northville station, which is the main one.

8. *Baird, Shasta County, California*—This station, on the McCloud River, is devoted exclusively to the cultivation of the California salmon, for which it is eminently adapted.

9. *Trout ponds near Baird, Shasta County, California.*—This locality, situated about 5 miles from the salmon station, is devoted to keeping up a large stock of California trout to supply eggs for eastern waters. The wild character of the region may be readily understood from the fact that the trout are fed on the meat of the black-tailed deer, as being the cheapest food that can be supplied to them.

10. *Wytheville, Va.*—In view of the expense attendant upon the transporting of the young Salmonidæ, such as California trout, brook-trout, landlocked salmon, &c., from Northville, Mich., and other stations, to distant points, especially the southern Alleghanies, it was concluded best to establish a station for hatching the same somewhere in the mountains of Virginia, as giving convenient access to the principal States having a water-supply fitted for the growth of such species. The Virginia fish commissioner had several years ago selected a locality near Wytheville, Va., as the most eligible spot known to him, and where an almost inexhaustible volume of cold spring water of the utmost purity was procurable. An arrangement was accordingly made to rent this station for the purpose in question, at a reasonable price; and a large number of eggs were sent there in the autumn of 1883, and successfully hatched out.

11. *Cold Spring Harbor, N. Y.*—For the purpose of hatching eggs of the salmon and of the whitefish for introduction into the rivers and lakes of Northern Pennsylvania, New York, and other adjacent States, arrangements were made to occupy, in part at least, the station of the

New York fish commission at Cold Spring Harbor, Long Island. This place is in convenient proximity to New York, and consequently enjoys excellent facilities for transportation and distribution. It is in charge of Mr. Fred Mather, who carries on simultaneously work for the State of New York and for the United States. Large numbers of salmon and other species have been successfully hatched out at this station and distributed to New York, Connecticut, and Pennsylvania.

Experiments will be made during the winter in the propagation of cod and tomcod at the Cold Spring Harbor station.

C.—PROPAGATION OF SHAD.

12. *Havre de Grace, Md.*—The work connected with the propagation of shad in their breeding grounds in the Susquehanna River, previously carried on by barges anchored in Spesutie Narrows, has been transferred to an artificial island known as Battery Island, which is a few miles below the railroad bridge at Havre de Grace. The facilities already established at this station were extended during the year, with the expectation of their yielding large results.

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

14. *Fort Washington, Md.*—This point was occupied this year for the first time, by permission of the War Department, and placed in charge of Lieut. W. C. Babcock, U. S. N.

D.—PROPAGATION OF CARP.

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

16. *Washington Arsenal grounds.*—Cultivation at this station is confined to the scale carp.

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

3.—NEW HATCHING STATIONS ASKED FOR.

1. *On the Columbia River.*—On January 18, 1883, Hon. J. H. Slater, United States Senator from Oregon, transmitted the following communication from the Astoria Chamber of Commerce, asking for the establishment of a salmon hatchery on the Columbia River or on one of its tributaries:

ASTORIA, OREG., *December* 29, 1882.

DEAR SIR: The Astoria Chamber of Commerce would respectfully ask for the establishment of a salmon hatchery by the General Government on the Columbia River or its tributaries.

It is expected that the railroad will be connected with the river, forming a continuous, uninterrupted line across the continent, before the month of August, 1883. and in time to distribute any spawn taken in that year.

The Columbia River salmon for distribution would be unequaled, while the restocking of the parent waters would be of great value.

The catch on the Columbia in 1882 was not less than 1,600,000 fish, and surely so great an industry and consumption needs fostering.

We exported from the Columbia River, in 1882, 540,000 cases, valued at $2,900,000.

There are twenty-four salmon canneries now at Astoria and ten more within 30 miles, representing a permanently invested capital, in ground, buildings, machinery, &c., of at least $850,000.

No other river in the United States produces so fine a quality of salmon (the Quinnat); it is preferred in every market of the world, has more oil and a finer color and flavor, and commands an average of 15 per cent in price over the product of any other river.

Respectfully submitted by order of the Astoria Chamber of Commerce.

E. C. HOLDEN, *Secretary.*

Hon. SPENCER F. BAIRD,
U. S. Commissioner of Fish and Fisheries, Washington, D. C.

Subsequently Hon. M. C. George wrote requesting the Commission to do anything in its power to further the proposition. Accordingly Mr. Livingston Stone was directed to make a careful exploration of the river and its tributaries during the summer. His report and recommendations will be found in the appendix to this volume.

2. *At Milwaukee, Wis.*—On the 15th of January, 1883, a communication was received from Philo Dunning, president of the Wisconsin fish commission, transmitting a copy of some resolutions which had been adopted by the Wisconsin commission, and also a copy of a joint resolution of the State legislature of Wisconsin. On the 5th of February, Hon. R. D. Torrey, general manager of the Milwaukee Industrial Exposition Association, transmitted a resolution passed by the directors of the association making a similar request.

The common council of Milwaukee also passed a resolution of approval of the project.

The Fish Commission was unable to comply with these requests, as it had not the means for establishing additional hatcheries, and as those at Northville and Alpena furnished facilities for taking care of all the eggs obtainable in that region.

The resolutions and memorials referred to above were as follows:

At a regular meeting of the Wisconsin fish commission held on the 7th of January, 1883, the following action was taken with reference to the location of the Northwestern branch of the United States fish hatchery in Milwaukee:

Whereas we believe in the industry of the artificial propagation of the better classes of native and foreign fish, and recognize with satisfaction the efforts the General Government, under the efficient management of Prof. Spencer F. Baird, U. S. Commissioner of Fish, is putting forth in this direction; and

Whereas we believe no better place can be found than is offered in the city of Milwaukee, Wis., for the location of the Northwestern branch of the Government hatchery: Therefore,

Resolved, That we cordially invite Professor Baird to examine the facilities offered in this city, at an early day, with reference to locating said branch in this place.

Resolved, That a copy of this action be sent to Hon. P. V. Deuster, M. C., with the request that he present the same to Professor Baird and use his influence in carrying out the purpose thereof.

PHILO DUNNING,
President.
C. L. VALENTINE,
Secretary.

MILWAUKEE, *January* 7, 1883.

Resolved, That we, the board of directors of the Milwaukee Industrial Exposition, fully indorse the action of the Wisconsin State fish commission in their efforts to secure the location of the Northwestern branch of the Government fish hatchery in this city, and cordially invite Prof. Spencer F. Baird, U. S. Fish Commissioner, to visit Milwaukee and examine the conveniences offered in the exposition building for such purpose.

MILWAUKEE, *January* 8, 1883.

Extract of the action taken by the board of directors of the Milwaukee Industrial Exposition Association.

R. D. TORREY,
General Manager.

Joint resolution No. 1, S., inviting Spencer F. Baird to visit the State with a view to the establishment of a fish hatchery, &c.

Resolved by the senate (the assembly concurring), That Spencer F. Baird, U. S. Fish Commissioner, of the U. S. Commission of Fish and Fisheries, be, and he is hereby respectfully invited to visit Wisconsin, either personally or through an agent to be designated by him for that purpose, with the view to the establishment within this State of a United States fishery and hatching house for fish, at some suitable place to be approved by him; and that a duly certified copy of this resolution, attested by the chief clerks of the senate and assembly, be forthwith transmitted to said Spencer F. Baird, at the city of Washington, in the District of Columbia.

CHARLES E. BROSS,
Chief Clerk of the Senate.
I. T. CARR,
Chief Clerk of the Assembly.

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

A.—THE STEAMER ALBATROSS.

The first year's work of this steamer has been very important and has fully met all reasonable expectations. During all of January and until the 10th of February she was at the Washington navy-yard, receiving apparatus and being put in condition for a cruise. It was found necessary, however, to return her to the shops of Pusey & Jones, at Wilmington, to make some alterations in the engines, which having been completed, the vessel started again for Washington on the 21st of March, arriving on the 25th. On the way several soundings and dredgings were made in from 82 to 641 fathoms. The vessel arrived at Washington March 25, the sounding and dredging apparatus having worked satisfactorily in these experimental tests, with the exception of the submarine electric light. On the 24th of April the vessel went to sea, under orders to investigate the conditions which govern the movements of the mack-

erel, menhaden, bluefish, and other migratory species, beginning off Hatteras and following up the schools in their movements. The physical conditions of the surroundings as to temperature and currents, as well as the chemical and biological peculiarities of the water, were also to be examined. The commander was directed to communicate with fishing vessels, in order to obtain information from them in regard to the movements of fish and their success in fishing. The dredging and trawling operations were to be carried on as frequently as opportunity offered. To what extent these purposes were attained may be seen by examination of the report of Lieutenant-Commander Tanner, U. S. N., in the appendix.

On the 31st of May the vessel went into the dry-dock at the Brooklyn navy-yard, where the magnetic survey of the vessel, which had been begun in April, was completed by Lieutenants Wainwright and Diehl, U. S. N., under direction of the Navy Department. She left New York on the 8th and arrived at Washington on the 19th of June. Preparations were then made for the summer cruise, which was commenced July 6, under orders quite similar to those of the previous trip. Capt. Jacob Almy, of New Bedford, accompanied the ship as a fisherman expert. During this cruise a large number of reports relating to the mackerel and menhaden fisheries were obtained from fishing vessels and factories, which will be found in Captain Tanner's report in the appendix. The Albatross ran into Wood's Holl on July 14, and left two days later, with a number of naturalists on board, for a dredging trip along the edge of the Gulf Stream. July 20th she went to Newport for coal, and returned to Wood's Holl on the 24th. From July 25 to August 1 was spent in dredging trips, during which many successful hauls were made. On the 6th of August the investigation of the menhaden and mackerel fisheries was resumed. The vessel proceeded by way of Newport to Block Island, No Man's Land, and the coast of Long Island. But very few fish were seen on this trip. She returned August 10, and on the 20th started out again in search of mackerel in the region about Nantucket, George's Banks, Cape Sable, Grand Manan, &c., returning to Wood's Holl September 6. During the various trips many fishing vessels were met with, and valuable statements obtained from them by Captain Almy, the substance of which is given in Captain Tanner's report.

Having taken coal at New Bedford, and made necessary repairs, the Albatross again started off on the 19th of September, for the purpose of making another examination of the tilefish grounds. The party returned on the 22d, having taken one swordfish and several kinds of smaller fish, but no tilefish. Between September 29 and October 5 a successful dredging trip was made to the Gulf Stream. Having coaled at Newport on the 12th of October, Captain Collins was taken on board as expert fisherman in place of Captain Almy, whose term of service had expired, and another cruise was then made for the pur-

pose of investigating the migrations of mackerel and menhaden. The vessel proceeded to Block Island, Barnstable Bay, Boston Bay, Gloucester Harbor, and returned southward by Stellwagen Bank, No Man's Land, and Sandy Hook. A call was made at the Brooklyn navy-yard to obtain coal and provisions. The vessel then cruised southward as far as Cape Hatteras, and entering the Chesapeake, arrived at Washington November 13. From this time until the end of the year the vessel was at the navy-yard refitting for a winter cruise. In the reports of Capt. J. W. Collins, Capt. Jacob Almy, Mr. James E. Benedict, Ensign R. H. Miner, U. S. N., Surgeon C. G. Herndon, U. S. N., Engineer G. W. Baird, U. S. N., and Lieut. Seaton Schroeder, U. S. N., all of which are embodied in the report of the commander and contained in the appendix, will be found the details of the several cruises and an epitome of the work accomplished.

The *personnel* of the steamer during the year consisted of —

Lieut.-Commander Z. L. Tanner, U. S. N., commanding officer.

Lieut. Seaton Schroeder, U. S. N., executive officer and navigator, in charge of hydrography and meteorology.

Lieut. Sidney H. May, U. S. N., watch officer, in charge of sounding apparatus.

Lieut. A. C. Baker, U. S. N., watch officer, in charge of dredging apparatus.

Ensign Clifford J. Boush, U. S. N., watch officer, in charge of electric apparatus.

Ensign R. H. Miner, U. S. N., recording officer, in charge of marine vertebrates.

Surgeon Jerome H. Kidder, U. S. N., medical officer, in charge of chemistry.

Paymaster George H. Read, U. S. N., pay officer, in charge of photography.

Passed Assistant Engineer George W. Baird, U. S. N., chief engineer, in charge of special mechanical appliances.

James E. Benedict, resident naturalist.

By direction of the Secretary of the Treasury, the collector of customs at Wilmington, Del., reported as follows in regard to the measurements of the Albatross:

Register length	feet..	205.00
Register breadth	feet..	27.50
Register depth	feet..	16.50
Measurement	tons..	385.88
Gross tonnage	tons..	638.82

This may be a suitable place to mention the fact that a model of the Albatross, furnished by Pusey & Jones, excited much interest at the London Exhibition, and a great desire was expressed to have the vessel herself sent there, in order that her many special and interesting peculiarities might be examined. It was, however, not considered expedient

to withdraw the vessel from her field of duty, as the extra expense could not be spared from the London Exhibition appropriation; neither could the cost of coal and other necessary expenses that would have been involved, be paid by the Fish Commission.

The Navy Department, through Commodore Walker, chief of the Bureau of Navigation, made application for the services of the Albatross in connection with the taking of soundings and other investigations in the Caribbean Sea, with the understanding that the expense of maintenance and repair of the vessel during the period of its transfer was to be assumed by the Navy Department. This was assented to, and preparations were duly made towards the end of the year. As, however, the cruise itself was made in the subsequent year, the report of 1884 will contain the details.

In a special report by Captain Tanner upon the construction of the Albatross and her operations for the year will be found many details of great scientific and practical interest. A full account is also given of the system of electric lighting, by Engineer G. W. Baird.

B.—The Steamer Fish Hawk.

This vessel remained during the entire year under the command of Lieut. William M. Wood, U. S. N. She was at the Washington navy-yard until March 15, when a trip was made to the Chesapeake, in search of the sperm whale reported ashore at Smith's Point, Virginia. The whale was not found, but the fisheries at Marlborough and Brent's Points were examined. A few shad and herring and quite a number of rock, perch, &c., were being taken.

On the 24th of March the Fish Hawk again left Washington, with a lot of material for Havre de Grace station. The vessel reached that point the next day, having called at the Saint Jerome station on her way. After coaling at Baltimore she proceeded to Saint Jerome and dredged for oysters a few hours. On the morning of the 1st of April she returned to the Washington navy-yard. On the 12th of April Lieutenant Wood sailed for Shipping Point, on the Potomac, with orders to commence the hatching of shad, herring, and rockfish, collecting eggs in that region of the river south of Gunston's Cove. The fisheries were found to be in successful operation, but it was some days before the fish were ripe enough to furnish suitable eggs for propagation. During the first ten days the temperature was very low, and over 7,000,000 herring eggs were lost by sudden changes of temperature. On the 7th of May the vessel was moved to Glymont, where the water was found to be both clearer and warmer. Nine hundred thousand herring and 60,000 perch eggs were taken the first day. The taking and hatching of eggs was continued at this point until about the 25th of May, when the vessel returned to Washington.

She was then ordered to prepare to sail June 4 for the mouth of the Chesapeake, and on the way to locate upon charts the pound-nets and

to report their season's work, names of owners, amount of fish taken, &c., both on the Potomac and in the Chesapeake. Lieutenant Wood was further directed to examine various points with a view to propagating Spanish mackerel and the oyster. The vessel arrived at Fairport, Va., on this mission June 6, and at Cherrystone, Va., June 12, which terminated this part of the investigation. An abstract of the information obtained concerning the pound-nets in the Potomac will be found in the Fish Commission Bulletin for 1883, pages 278–280. A call was made at Hampton upon Professor Brooks, who was found at his laboratory experimenting upon oysters.

The vessel arrived at York Spit June 18, and commenced prospecting for Spanish mackerel. On the 21st the first ripe spawn was obtained, and the vessel was continuously engaged in this work until the 3d of August. An account of the work and of some new apparatus which was employed will be found in two papers in the appendix, one by Lieutenant Wood and the other by Dr. J. Alban Kite.

On the 13th of July the vessel was anchored off Ocean Beach, near Hampton Roads. That evening a sudden heavy storm caused the vessel to drag her anchor and blew her ashore. Assistance was obtained on the 14th from the Baker Wrecking Company, of Norfolk, and at different times from the Army tug Monroe, the U. S. S. Pinta, the tug Snowdrop, the revenue-cutter Ewing, and the lighthouse tender Holly. At 5 a. m. on the morning of July 18 the ship was floated. Fortunately it was found that but little injury had been done.

On the 5th of August the vessel was coaled in Baltimore, and on the 13th an unsuccessful attempt was made to get some more Spanish mackerel eggs. After being delayed at Hampton by bad weather until the 17th Lieutenant Wood proceeded, by way of Sandy Hook and Hell Gate, to Wood's Holl, where he arrived on the evening of August 20. On the 22d the vessel sailed for a trawling trip to the edge of the Gulf Stream. Several stations were made, and the vessel returned to Wood's Holl on August 24.

The Decatur H. Miller, of the Merchants and Miners' Transportation Line, being reported ashore in Vineyard Sound September 23, Lieutenant Wood immediately went to her assistance, finding already there the Coast Survey steamer Blake and the revenue steamer Dexter. By their joint action the vessel was floated the same evening. The services of the Fish Hawk in connection with the relief of the Decatur H. Miller were formally acknowledged by the secretary of the company.

The Fish Hawk remained with headquarters at Wood's Holl until October 16, when she took on board certain freight for Washington. Having called at Newport to coal and at New York for provisions and stores and 100 live lobsters to be deposited in Chesapeake Bay, she arrived at the capes October 27 and at Washington on the 30th. An account of the transfer and successful plant of the lobsters near Fort Wool will be found in the Bulletin for 1884, page 16.

The next work assigned to the Fish Hawk was that of laying out oyster-ponds at Saint Jerome station, for which purpose she left Washington November 12, and arrived at Saint Jerome the next day. An account of the dredging and of the laying out of three oyster-ponds will be found in the appendix to this report. The vessel returned to Washington November 26, where she remained until the close of the year.

A renewed measurement of the tonnage of the Fish Hawk was made under order of the Treasury Department, the figures being 441.40 tons gross measurement and 205.1 tons net measurement; signal letters G. V. Q. C.

The officers during the year were as follows:

Lieut. W. M. Wood, U. S. N., commanding officer.

James A. Smith, mate and executive officer.

D. H. Cleaveland, mate.

William L. Bailie, passed assistant engineer, acting chief engineer.

J. Alban Kite, M. D., civilian, apothecary.

C.—The Lookout.

The steamer Lookout, belonging to Mr. T. B. Ferguson, and used by the Fish Commission since 1878 without any compensation to the owner, has continued to render excellent service in the operations of the Commission, partly in transporting supplies between Washington and the stations at Saint Jerome and Havre de Grace, and partly in close relationship with the propagation of shad, Spanish mackerel, and oysters.

As stated in the previous report, Lieutenant Wood having been transferred to the command of the Fish Hawk on the 20th of November, 1882, the command of the Lookout devolved upon Chief Quartermaster William Hamlen, whose long service with the Fish Commission and zealous performance of his duties warranted his being continued in this responsible position during the year, especially as on so small a vessel proper accommodations for a naval officer of rank could not be provided.

Soon after the change in the command of this steamer she was transferred from the head of the Chesapeake Bay to the Washington navy-yard, and Mr. Hamlen was detached temporarily to conduct some experiments in hatching codfish at Fulton Market, New York City.

Towards the end of February, the vessel having been equipped for a southern cruise, Lieut. Francis Winslow was instructed to make some investigations as to the oyster-beds of the Potomac River and Chesapeake Bay while the steamer was on the way to Norfolk. On the 3d of March she sailed from Norfolk to Charleston, by the inland route, and arrived at Beaufort, N. C., on the 6th, where she was storm-bound until the latter part of the month.

The collector of customs, by direction of the Secretary of the Treasury, caused her to be measured while she was at Charleston, and re-

ported her gross tonnage 54.49, net tonnage 28.76; and signal letters G. V. Q. D. were assigned her.

On the 19th of that month she was joined at Charleston by Assistant Commissioner T. B. Ferguson, who proceeded to Florida for the purpose of investigating the condition of the shad fisheries on the Southern Atlantic coast, with a view of establishing hatching stations. Extracts from Mr. Ferguson's report on this inspection will be found on page 244 of the fourth volume of the Fish Commission Bulletin (1884). The Lookout returned to Charleston on the 2d of April, the investigations in the more southern waters having been hurriedly made on account of being due at Washington to report for work on the Potomac and Susquehanna Rivers.

She arrived in Washington on the 19th, but having been run into by a schooner in the narrow channel near the navy-yard, she was sent to Baltimore for repairs, which were completed by the 2d of May. She was immediately transferred to the Potomac River, where she materially aided in the prosecution of the shad-hatching operations in that locality.

During the month of June she was employed as a dispatch boat in making inspections of the Saint Jerome and Battery stations; but, unfortunately, on the 30th of the month, while proceeding down the Potomac, her shaft broke. This accident deprived the Commission of her services until the necessary repairs could be made. Secretary Chandler having given instructions for the repairs to be promptly made at the Washington navy-yard, they were completed by the 11th of July, and on the following day she sailed for the Lower Chesapeake, and was employed during the rest of the month in hatching the Spanish mackerel and investigating the oyster-beds in that region.

In September she was utilized for transferring flumes, to be used in the oyster-ponds, from Saint Jerome station to Norfolk, to be treated with preservatives.

This service was intermitted by the transfer of the vessel for a time to the subcommittee of the Senate Committee on Foreign Relations, Senator Lapham, chairman, which was engaged in making inquiries into the condition of the menhaden fisheries of the Chesapeake. On the completion of this work she resumed the transfer of the lumber between Saint Jerome and Norfolk, and then returned to Washington.

After a short stay she was again employed in connection with the Saint Jerome station during November.

At the close of the year the Lookout was laid up at the Washington navy-yard to undergo repairs and some alterations for the purpose of better adapting her to the varied services which she might be called upon to perform.

D.—Launches.

The only launch actually belonging to the miscellaneous service of the Commission, Herreshoff, No. 82, was in constant service during the

year. In the spring she served as a tender to the work of fish propagation at Battery Station, and in the summer she was used in connection with the marine investigations at Wood's Holl. By reason of her general seaworthiness, she was able to proceed without convoy to the New England coast, and to return without any damage.

The other launches, belonging to the Navy Department, were also in constant use and kept in thorough repair by the Commission.

E.—The Canvas-Back.

In a previous report reference was made to a small light-draft steamer, which it was considered desirable to have for service in laying out the seine over the shoal waters at Battery Station. Although such a vessel would have been very desirable, no appropriation was available for its construction, and the project remains in the same condition as last year.

F.—Proposed Fishing Schooner.

Reference has been made in previous reports to the project of having a schooner constructed with a well, in which living fish might be transported from place to place, to be used more especially as a tender to the Wood's Holl station in bringing in living codfish, halibut, and other species from distant points, to be kept in basins until the eggs were ripe for removal. Such an appendage is deemed absolutely necessary to the proper working of the Wood's Holl establishment.

Capt. J. W. Collins, one of the assistants of the Fish Commission, and who for many years has been a highly successful practical fisherman of Gloucester, was directed to prepare a model, drawings, and specifications of a suitable vessel that should contain, as far as possible, all the best qualities of the fishing service of both America and Europe, and serve as a suitable mean between the comparatively shoal schooners used in the United States and the deeper draft of the European smack. Well fitted by his previous experience, he utilized his attendance upon the Berlin Fishery Exposition in 1880, and that of London in 1883, to solve the problem submitted to him; and a model which the U. S. Fish Commission exhibited at London was highly approved by those who were competent to criticise and judge. It is hoped that Congress may at an early date furnish the means for building such a vessel, and not only aid the Commission in carrying out its work, but also in supplying a pattern for imitation by the fishermen.

Very few persons realize the annual loss of property and life incurred in connection with the fishing fleet of New England, especially off George's Banks, which are not improperly called "Gloucester's graveyard." There has been for many years an average destruction of 10 vessels and the loss of 100 lives; sometimes the figures are considerably larger. These vessels, for the most part, founder and disappear entirely, without leaving any trace behind or any suggestion as to the actual causes of their destruction.

5.—FISH HATCHING AND TRANSPORTATION CARS.

Reference has been made in previous reports to the important service rendered the Commission by its two cars.

Of these, No. 1 consisted of a first-class baggage car formerly belonging to the Philadelphia, Wilmington, and Baltimore Railroad Company, fitted up for the required service. It is 51 feet 2 inches long, without platform; with platform, 57 feet 6 inches; total height from the track to the topmost projection, 14 feet 1½ inches; total width, 9 feet 10 inches.

The experience gained by using this car was subsequently utilized in the construction of a second car for the Commission by the Baltimore and Ohio Railroad Company, and which contained many important improvements upon the work of car No. 1.

The dimensions of car No. 2 are 59 feet 9 inches in length between the outer ends of the buffers; height, 14 feet ⅞ inch from the top of track to top of hood; width, 10 feet.

The efficiency of these cars and the service rendered by them in the work of the Commission, both in the transportation of young fish and in the hatching of eggs, render a third very desirable. Plans for this have been prepared, and will be applied in the event of an appropriation for the same being granted by Congress. Details in regard to the uses made of these cars during the year will be found in the report of the distribution division. It may, however, be interesting to learn that car No. 1 traveled during the year 31,993 miles in the distribution of carp, salmon, and shad. The number of shad distributed was 6,715,000; of herring, 5,550,000; of carp, 113,605; and of salmon, 450,000.

6.—COURTESIES EXTENDED TO THE U. S. FISH COMMISSION.

A.—By the Government.

As in previous years, I have the pleasure of acknowledging many important courtesies extended to the Commission by the various Departments of the Government, by railroad and steamboat companies, and by individuals. Indeed, without the help thus rendered it would be quite impossible to carry on the work on its present scale without a very considerable increase in the appropriations.

Treasury Department.—*Secretary's Office.*—Mr. Hobbs was authorized by the Secretary of the Treasury on the 8th of August to disburse the appropriation for the Wood's Holl buildings.

Light-House Board.—The Light-House Board, May 28th, authorized the further use of the storage building at Wood's Holl previously occupied by the Commission. Instructions were given to the inspector of the second light-house district to place a mooring for the Albatross in Great Harbor, Wood's Holl, Mass. The Light-House Board has continued to assist in taking ocean temperatures at about thirty-five of the light-houses and light-ships most favorably located.

Coast Survey.—It has been found necessary to call frequently upon the Coast Survey for tide-tables, maps, and charts required for the use of the different vessels of the Fish Commission, which have always been promptly furnished.

Life-Saving Service.—In connection with the propagation of codfish in the vicinity of New York, certain life-saving crews were directed to aid the employees of the Fish Commission.

The arrangement made by the Superintendent of the Life-Saving Service, early in the year, for the telegraphic announcement to the Smithsonian Institution of the stranding of marine animals has already been productive of important results. The series of specimens thus far received is in every way remarkable, and should the system continue to be so productive it is impossible to say what good may not result to zoology. The first specimen received was that of a shark (*Pseudotriacis microdon*) from Station No. 10, Amagansett, N. Y., Mr. Joshua B. Edwards, keeper. This species had hitherto been captured only off the coast of Portugal, and its discovery in our waters was a matter of great interest to American ichthyologists. The only other specimen known to be preserved is the type of the species.

Shortly after this shark was received a still more remarkable animal was announced from Station No. 8, at Spring Lake, N. J., Mr. Henry S. Howland, keeper. This was a pigmy sperm-whale of the genus *Kogia*, a form entirely new to the North Atlantic. Few specimens of this genus have ever been collected, and these from the most remote parts of the globe, some from New Zealand, and one from Mazatlan, at the entrance of the Gulf of California. These animals resemble the great sperm-whale, to which they are closely related, but do not seem to attain a length of more than 9 or 10 feet, and are truly the pigmies of their race. The New Jersey specimen was peculiarly interesting in that it was a female with young. In dissecting the animal a fetus fully 3 feet long was found, which is probably the first ever seen by the naturalist.

The interest aroused by the arrival of this specimen had scarcely abated when the stranding of another cetacean was announced from Station No. 17, at Barnegat City, N. J., Mr. J. H. Ridgway, keeper. This remarkable animal floated in upon the tide and was secured by Mr. Ridgway and his crew after considerable exertion. The curator of mammals and an assistant were dispatched from the National Museum, and a cast of the exterior was made and the skeleton prepared for shipment to Washington. As the huge animal lay upon the sand the question of its identity proved quite a puzzling one to the zoologist who viewed it; but when the skull was cut out, it was at once apparent that the animal belonged to the whales known as the Ziphioids, and probably to the species *Ziphius cavirostris*, an animal for which no common name exists, but which may be termed a bottle-nose whale. It is probably the second specimen ever taken on the coast of the United States.

Ziphioid whales have a most interesting history. In ages past they were very abundant, perhaps as much so as the common porpoise of to-day, but at present only stragglers are found in remote quarters of the globe. It would seem as if they were but the surviving relics of a great race, which sprang into existence, reached the maximum of its abundance, and declined long ages before man appeared on the earth. Many species occur as fossils in connection with the phosphate deposits of South Carolina.

From Station No. 20, at Fire Island, N. Y., Mr. Daniel S. Hubbard, keeper, and Station No. 37, at Turtle Gut, N. J., Mr. Uriah Gresse, keeper, came two specimens of a porpoise, which, unlike the cetaceans which have been already referred to, is of common occurrence on our Atlantic coast, and is probably also represented in European waters. The casts, however, which the National Museum was enabled to make are probably the first of the species in any museum in the country, and, with the skeletons, which were preserved, form an excellent basis for comparison with other forms. The animal is commonly known as the bottle-nose dolphin, and is identical with or closely allied to the species *Tursiops truncatus*.

In addition to the shark previously mentioned, several peculiar and interesting fishes have been received. Among these is a fish known as the "star-gazer" (*Astroscopus anolophus*), from Station No. 6, at Deal's Island, N. C., Mr. Malachi Corbel, keeper. The "star-gazer" is a southern species which occasionally strays northward as far as Cape Cod, but it is very rare in museums. A very closely allied species (*anolophus* var. *grœcum*) is said to possess electrical power in life. From Station No. 2, at Point Judith, R. I., Mr. Herbert M. Knowles, keeper, was received a specimen of the "lumpfish." The "lumpfish" (*Cyclopterus lumpus*) as a rule is an inhabitant of colder waters than that in which it was found. The "flute mouth" (*Fistularia serrata*), from the same station, is a very rare species on our coast. The "angel fish" (*Pomacanthus arcuatus*), taken at Barnegat City, N. J., has not hitherto been known north of Florida.

WAR DEPARTMENT.—Permission was given May 28th, by the Acting Secretary of War, for one of the steamers to land at the Arsenal wharf, and to occupy it whenever not engaged at the fisheries.

Engineer Bureau.—March 23d the Chief of Engineers, General H. G. Wright, granted permission to use the fishing-shore at Fort Washington for the purpose of propagating shad, with the understanding that the grounds should be vacated whenever the Department should so request. Subsequently a like permission was granted to use one of the buildings at the fort as headquarters for the men.

The Bureau furnished maps of the Columbia River, to be used in the tour of exploration by Mr. Livingston Stone.

Signal Office.—General Hazen furnished weather indications to the Lookout on the trip to South Carolina in the spring, and also sent

weather telegrams to Wood's Holl during the summer season. He also replaced several broken thermometers for the use of lighthouse keepers in taking temperature observations.

NAVY DEPARTMENT.—The officers and crews of all the vessels of the Fish Commission have been furnished by the Navy Department during the year, and all the facilities of the navy-yards, particularly that at Washington, have been extended.

Bureau of Construction and Repair.—March 22d the chief of this Bureau authorized the continued use of Navy launches Nos. 55 and 49. May 16th the chief of this Bureau gave instructions to the commandants at New York and Norfolk to dock and paint the Albatross.

Bureau of Equipment and Recruiting.—April 13th Commodore English authorized the detail of machinist, fireman, and seaman for the new launch. April 16th Commodore English authorized the commandants of the navy-yards at Boston, New York, Norfolk, and Washington, and the Superintendent of the Naval Academy at Annapolis, to furnish coal to Fish Commission vessels upon requisition. January 4th, at the request of Captain Tanner, an exchange of galleys was made between the Albatross and the Wyandotte.

Bureau of Ordnance.—April 13th the Bureau furnished a 3-inch breech-loading howitzer for the Albatross; also small-arms for the Albatross, and powder-tanks for use in making collections of specimens.

Naval Constructor Pook rendered assistance in making drawings for a fishing smack.

POST-OFFICE DEPARTMENT.—This Department established a post-office at the McCloud River salmon station, naming it Baird; and Mr. Radcliff was appointed postmaster January 18.

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

B.—BY THE RAILROADS OF THE UNITED STATES.

In the earlier years of the work of the Commission the distribution of eggs and young fish was made in the baggage cars of the ordinary passenger trains, the special privilege being granted of having the fish carried without extra charge, and free access allowed to them on the part of the messengers of the Commission. The value of this concession may be readily understood from the fact that the equipment usually consisted of ten or twelve cans of 10 or more gallons capacity each, and requiring, of course, a large amount of standing room, and involving a great deal of wetting of the floor.

Nearly all the railroads in the United States cordially assented to this condition, an official circular being obtained from each one, which was carried by the messengers and presented on occasion. So hearty was the co-operation of the roads with this enterprise that cases were

not wanting where important freight was left behind in order to permit the fish to be carried through without detention.

Since the introduction, however, of transporting cars, this method of distribution has been very largely given up, being now employed only for service of localities within a few hundred miles of Washington.

While some railroads carried these cars free of any charge whatever, most of the others have exacted only a very trifling sum, generally 20 cents per mile for the car and five messengers, any additional number of messengers, when required, paying regular fares. The principal roads charging the twenty cents per mile, or thereabouts, are as follows:

Alabama Great Southern Railway; Chattanooga, Tenn.
Atchison, Topeka and Santa Fé Railroad; Topeka, Kans. (In part only. See below.)
Atlanta and West Point Railroad; Atlanta, Ga.
Baltimore and Ohio Railroad; Baltimore, Md.
Chesapeake and Ohio Railway; Richmond, Va.
Chicago and Northwestern Railway; Chicago, Ill.
Chicago, Burlington and Quincy Railroad; Chicago, Ill.
Chicago, Milwaukee and Saint Paul Railway; Chicago, Ill.
Cincinnati, Indianapolis, Saint Louis and Chicago Railway; Cincinnati, Ohio.
Columbus, Hocking Valley and Toledo Railway; Columbus, Ohio.
East Tennessee, Virginia and Georgia Railroad; Knoxville, Tenn.
Georgia Railroad; Augusta, Ga.
Illinois Central Railroad; Chicago, Ill.
Louisville and Nashville Railroad; Louisville, Ky.
Marietta and Cincinnati Railroad (now Cincinnati, Washington and Baltimore); Cincinnati, Ohio.
Minneapolis and Saint Louis Railroad; Minneapolis, Minn.
Nashville, Chattanooga and Saint Louis Railway; Nashville, Tenn.
New York and New England Railroad; Boston, Mass.
New York, New Haven and Hartford Railroad; New York, N. Y.
Pennsylvania Railroad; Philadelphia, Pa.
Pennsylvania Company:
Jeffersonville, Madison and Indianapolis Railway; Louisville, Ky.
Pittsburg, Cincinnati and Saint Louis Railway.
Pittsburg, Fort Wayne and Chicago Railway.
Petersburg Railroad; Petersburg, Va.
Raleigh and Gaston Railroad; Raleigh, N. C.
Richmond and Danville Railway; Richmond, Va.
Richmond and Petersburg Railroad; Richmond, Va.
Richmond, Fredericksburg and Potomac Railroad; Richmond, Va.
Terre Haute and Indianapolis Railroad; Terre Haute, Ind.
Virginia Midland Railway; Alexandria, Va.
Western Railroad of Alabama; Montgomery, Ala.

The following roads performed this service free, except the Saint Louis, Keokuk and Northwestern, which made a charge of 10 cents per mile:

Missouri Pacific Railroad.
Saint Louis, Keokuk and Northwestern Railway.
Atchison, Topeka and Santa Fé Railroad.
Flint and Père Marquette Railway.
Utah Central Railroad.
Northern Pacific Railroad.

The Northern Pacific Railroad issued a free pass for Mr. Livingston Stone to traverse that line during his explorations of the Columbia River with a view of establishing a salmon hatchery.

C.—By Foreign Steamship Companies.

In addition to the companies that have heretofore rendered facilities, Messrs. Peter Wright & Sons, general managers of the Red Star Line, have offered to carry fish to Liverpool free of charge.

D.—By Foreign Countries.

Germany.—Several attempts were made by Herr von Behr to send some of the blue carp of Germany. During January a shipment of eight arrived to the care of Mr. Blackford, who forwarded them to Washington, but most of them died, having suffered from fungus and bruises. On May 8th, five were received in good condition from the *Deutsche Fischerei-Verein*, the survivors of forty which had been forwarded by Mr. Busse, of Geestemünde.

7.—Courtesies to foreign countries.

Nearly every year of the Fish Commission's existence eggs or fish have been sent to foreign countries in response to properly authenticated requests. Within the present year a larger number of applications have been made than usual. This has been caused, perhaps, by the success which has heretofore largely attended shipments abroad.

France.—On the 3d of January 200,000 whitefish eggs and 50,000 lake-trout eggs were placed on the steamer Labrador for transmission to the Society of Acclimation in Paris, where they arrived in perfect condition.

On the 6th of February 20,000 brook-trout eggs from the station at Northville were shipped from New York by steamer St. Laurent. Receipt of these in perfect condition was acknowledged by the society under date of March 3.

March 7th, 15,000 landlocked salmon eggs were forwarded by steamer to the same society. These are reported to have arrived in perfect condition March 31st. An illustration of the results of the efforts to acclimatize California salmon in France will be found in the Fish Commission Bulletin for 1884, page 138, from which it appears that at three different times salmon measuring from 25 to 30 centimeters in length have been taken in the river Aube, which were no doubt results of eggs sent by the U. S. Fish Commission in 1879, 1880, and 1881.

Germany.—On Saturday, January 6th, there were forwarded by a North German Lloyd steamer 25,000 brook-trout eggs, 100,000 lake-trout eggs, and 500,000 whitefish eggs. These were all for the *Deutsche Fischerei-Verein*, and were sent to the care of F. Busse, Geestemünde. Under date of January 19th, Herr von Behr announced the safe arrival of the whitefish eggs and the brook-trout eggs, but that, as many of the lake-trout eggs hatched out on the way, only about 30 per cent of

the lake-trout lot could be saved. On the 10th of March 25,000 landlocked salmon eggs were sent to the *Deutsche Fischerei-Verein* by steamer Neckar. Under date of April 1, Herr von Behr wrote that the landlocked salmon eggs "arrived in wonderful condition."

In February Mr. George Eckardt undertook to carry 7 large-mouth and 45 small-mouth black bass with him to Germany, and he arrived safely with the bass February 27. He delivered them to Max von dem Borne, at Berneuchen. Subsequently a large proportion of the fish died, probably in consequence of the long journey; but 3 of the former and 10 of the latter survived the winter of 1883–'84. The large-mouth bass spawned in the spring of 1884, and more than 2,000 young were obtained. Three of the old ones had grown very rapidly by this time, and measured more than 12 inches in length.

Great Britain.—On the 2d of February 10,000 brook-trout eggs were sent by Cunard steamer Catalonia to the Norfolk and Suffolk Acclimatization Society, of which Hon. W. Oldham Chambers is secretary. Under date of February 26th he reported their arrival in excellent condition.

On March 7th, 10,000 landlocked salmon eggs were forwarded by Cunard steamer Bothnia to the same address. Under date of April 6 the safe arrival of these eggs was announced. They also hatched with very small loss.

Belgium.—Application having been made by Hon. E. Williquet, of Ghent, for catfish, several efforts were made to forward them, but, the specimens offered being unsuitable, further efforts were deferred until another year. The White Star Line to Antwerp, Peter Wright & Sons, general managers, kindly offered to transmit the catfish free of charge.

Cuba.—Two large cans containing 26 carp were forwarded by steamer Newport from New York to Mr. Odvards, Havana, Cuba. Under date of March 17 he reported that 3 of them died during the trip and 7 after arrival, and that the remainder were in good condition.

Brazil.—Under date of January 6, Mr. J. W. Couchman, of Rio Janeiro, reported the safe arrival of 13 carp out of 100 that had been forwarded thirty-nine days previously from New York by the steamer Borghese.

United States of Colombia.—On the 14th of January Don Ricardo Becerra, of Bogota, received at New York 6,000 brook-trout eggs and 100 carp, which he took home with him to Bogota.

Mexico.—On the 25th of January there were forwarded to Mr. Blackford, New York, 50 carp, to be sent by the New York and Mexican Steamship Line to A. B. Clark, San Luis Potosi, care of Messrs. D'Oleire & Co.'s Successors, Vera Cruz, for Eugene Pigeon, San Luis Potosi.

8.—THE LONDON AND OTHER FISHERIES EXHIBITIONS.

In a previous report mention is made of the passage of an act by Congress authorizing and directing the participation by the United

States, through its Fish Commission, in the London International Fisheries Exhibition of 1883.

The preparations, begun in July, 1882, were carried on with great activity, and on the 26th of February a preliminary exhibition of such material as could conveniently be displayed was held in the National Museum, continuing two evenings and two days.

The work of packing the collections for transmission to London was begun on the 27th of February. The first shipment of goods was made on the 7th of March, the last on the 14th of April. A satisfactory arrangement was made, through the agency of Col. Thomas Donaldson, (1) with the Pennsylvania Railroad Company, for the transmission of the collections to New York and placing them on board of the steamer, and (2) with Messrs. Patton, Vickers & Co., agents of the Monarch Line of steamships between New York and London, for reduced freights, the rates given covering the transmission of the collections to London and back to New York.

The party accompanying the collections consisted of Mr. Goode, who, in the inability of the Commissioner of Fisheries to attend, was appointed special commissioner, Dr. Tarleton H. Bean, Mr. R. Edward Earll, Capt. Joseph W. Collins, Mr. A. Howard Clark, Mr. William V. Cox, Mr. Reuben Wood, and Capt. H. C. Chester. All of these gentlemen were permanent members of long standing of the staff of the Fish Commission and National Museum, excepting Mr. Wood, who was selected to represent the angling interests, being one of the champion fly-casters of the United States, and an expert in all matters relating to fine tackle. In addition to those already named, Lieut. C. H. McLellan, U. S. Revenue Marine, was detailed by the Life-Saving Service; Mr. Max Hansmann from the Light-House Board; and Sergt. James Mitchell, U. S. A., from the Signal Office, to accompany and instal the collections sent over by their respective departments. Mr. R. I. Geare also accompanied the party as stenographer for work upon the report.*

The collections arrived in London in excellent condition. It was soon found that the space of 10,000 feet asked for by the United States was entirely inadequate for the purposes, being inconveniently arranged and badly cut up by partitions and passage-ways. Additional, but insufficient, space was subsequently obtained in various parts of the exhibition grounds, the most useful portion being a section of about 2,500 feet graciously conceded by the Danish commissioner, Mr. Howitz. The life-boats were placed in a shed erected by us in one of the gardens,

* On March 20, Messrs. Earll, Clark, Cox, and Chester sailed from Philadelphia; on March 31, Messrs. Goode, Collins, Hansmann, and Mitchell; on April —, Messrs. McLellan and Wood; on June 16, Mr. Geare; and on June 30, Dr. Bean. Mr. Wood arrived home August 7; Mr. Clark, August 25; Lieut. McLellan, August 29; Mr. Hansmann, September 16; Mr. Geare, September 18; Messrs. Goode and Collins, September 30; Sergt. Mitchell, November 22; and Messrs. Earll and Cox, January 10. Captain Chester returned finally January 16, having made a trip to the United States, for the summer work of the Fish Commission, from July 16 to October 14.

three of the fishing boats upon the lake, and the salted, smoked, and preserved fish in a special building put up for articles of this description, in an unfortunately remote portion of the grounds.

The exhibition was held in the grounds of the Royal Horticultural Society in South Kensington, nearly on the sites of the great London exhibitions of 1851 and 1862. It was the largest special exhibition ever held, being participated in by thirty-one nations and colonies. The area occupied was 21 acres, about one-third of the space being covered with temporary buildings, and the remainder devoted to lakes and gardens, which were decorated and arranged in the most attractive manner, and afforded a delightful breathing and resting place for visitors to the exhibition.

Although conducted by a corporation of private citizens, the exhibition was practically a Government enterprise, its patron being Her Majesty the Queen, and the president the Prince of Wales. It was formally opened and closed by the Prince of Wales, in the presence of the court and its most prominent officials and promoters, who were men in high official position. The surplus proceeds are to be devoted to some public enterprise, such as the improvement of the condition of the fishermen's widows and orphans or the establishment of a zoological marine laboratory for the benefit of the fisheries.

The buildings assigned to the United States being of a temporary nature, mere rough sheds of unplaned boards, whitewashed with some fire-proof preparation, it was necessary to prepare them by painting them in distemper, both for appearance sake and to prevent the disfigurement of the collections from the constant shower of flakes of whitewash. This occasioned some delay, but by dint of hard labor, night and day, our party succeeded in getting the section into presentable form in time for the formal opening, which took place on the 12th of May, having been deferred nearly two weeks on account of the illness of the Queen.

After the opening, several weeks were occupied in attaching labels and finally adjusting the collections, but by June 1 everything was in thorough order, and the section was generally admitted to possess the greatest interest and to be the most important single division of the entire exhibition, both on account of its contents and the manner in which they were displayed. The following paragraph from the Pall Mall Gazette is a sample of several hundred of a similar tenor which might be quoted:

"The United States section is a department whose importance grows upon the inquiring visitor at every inspection. With fisherman and angler alike it holds the supreme position in the entire exhibition. The section forms a very flattering manifestation of international courtesy upon the part of the Government at Washington, for by far the largest part of the exhibits are from the National Museum and from the storehouses of the U. S. Fish Commission—an institution for which

it would be rather difficult to find an English counterpart—the private exhibitors, particularly trading exhibitors, being very few. Of the comprehensiveness and completeness of this truly national exhibition it is impossible to speak too highly."

Again, Major-General A. Pitt Rivers, a prominent ethnologist, in a letter to the editor of the Times, remarked as follows:

"In confirmation of the praise you justly bestow upon the arrangement of the United States department in the Fisheries Exhibition, I beg leave to draw attention to the fact that in the whole exhibition it is the only one which is arranged historically. In the Chinese, Japanese, Scandinavian, and Dutch courts, there are objects which the scientific student of the arts of life may pick out and arrange in their proper order in his own mind; but in that of the United States, * * * following the method adopted in the National Museum at Washington, [there has been] attempted something more to bring [the] department into harmony with modern ideas. * * * This gives the exhibition a value which is apart from commerce, and an interest which is beyond the mere requirements of fish-culture, and it may be regarded as one out of many indications of the way in which the enlightened Government of the United States marks its appreciation of the demands of science."

Again, Mr. James Russell Lowell, minister to England, in a dispatch to the Secretary of State, under date of May 19, wrote:

"I have the honor to report that the International Fisheries Exhibition promises to be far more successful than even the most sanguine of its projectors had ventured to hope. The wisdom of Congress in making so liberal an appropriation in furtherance of its object is entirely justified both by the substantial encouragement given to the enterprise at its inception by this proof of interest on the part of the United States, and by the fact that the section devoted to our country is more valuable than that of any other, and valuable for reasons of which we may very properly be proud.

"I have the highest authority for saying that, quite apart from any consideration of intrinsic interest or curiosity, our share in the exhibition is superior to all others, in virtue of the scientific intelligence shown in its arrangement and classification, thus rendering it more instructive than any other. This is especially gratifying, because it is a triumph of a far higher kind than could be won by any ingenuity in our contrivances for the breeding or mechanical perfection in our implements for the taking of fish, though in these also we may safely challenge and in some cases defy comparison.

"The credit of this unquestioned success is due undoubtedly, in the first place, to Professor Baird, whose absence is universally regretted, but hardly less to the intelligence, zeal, and untiring energy of Professor Goode and his assistants, who worked literally night and day in order to be ready for the day fixed for the opening of the exhibition.

"I shall naturally have occasion to write again and more fully on this

topic when more perfectly informed, but could not deny myself the pleasure of reporting to you the impression already made in this international competition by the genius for organization of which our countrymen have here given proof, a faculty certainly not the lowest among those that distinguish the social and civilized man."

These paragraphs are reprinted here simply to give an idea of the appreciative enthusiasm with which the participation of the United States in the Fisheries Exhibition was received in England. It was generally understood that the action of Congress in making an appropriation for this purpose decided the fate of the enterprise, in so far at least as its international character was concerned, since many nations which had before been undecided as to their action were finally influenced on account of this evidence of international courtesy and comity.

The members of our party express themselves as having been extremely gratified by the courtesy and aid which they received at the hands of the managers of the exhibition, particularly Mr. Edward Birkbeck, chairman of the executive committee, to whom, indeed, the inception and the success of the exhibition is mainly to be attributed; Professor Huxley; Sir Philip Cunliffe-Owen; Mr. A. J. R. Trendell, literary superintendent; Surgeon-General Francis Day; Mr. Fell-Woods; Mr. W. Oldham Chambers; and Sir James Gibson Maitland. From the opening of the exhibition, on May 12th, to its close, October 30th, the buildings and grounds were thronged with visitors, not only in the day but at night, when the buildings and grounds were illuminated by electric lights. The exhibition was a favorite resort for the London people through the summer, and was rendered more attractive by two daily open-air concerts by military bands. The total number of visitors was 2,690,000, an average of 18,545 per day.

On the 18th of June began the international fishery conferences at the exhibition, the opening address being given by Professor Huxley, the Prince of Wales in the chair. These conferences continued for nearly three months, taking place every day except Wednesday and Saturday, and two papers usually being read at each session. The chair was always taken by some distinguished man, and the reading of each paper was followed by general discussion. The attendance varied from one hundred to five hundred, a considerable number of the attendants being official delegates sent by the various Governments participating in the exhibition, selected on account of their familiarity with fisheries and kindred topics. About fifty papers were read, many of them of great importance, and dealing with subjects never before taken up for discussion. June 25 was devoted to the fisheries of the United States, and a paper was read by Mr. Goode upon "The Fishery Industries of the United States and the Work of the U. S. Fish Commission," Mr. James Russell Lowell presiding. In seconding the vote of thanks, Professor Huxley, in the course of his remarks, said: "The great moral of the United States contribution to this exhibition * * * was that if this country, or any society which could be formed of sufficient extent to take up the

question, was going to deal seriously with the sea fisheries, and not to let them take care of themselves, as they had done for the last 1,000 years or so, they had a very considerable job before them; and unless they put into that organization of fisheries the energy, the ingenuity, the scientific knowledge, and the practical skill which characterized his friend, Professor Baird, and his assistants, their efforts were not likely to come to very much good. One of his great reasons for desiring that the subject which * * * had been put before them should be laid distinctly before the English public was to give them a notion of what was needed if the fisheries were to be dealt with satisfactorily, for he did not think, speaking with all respect to the efforts made by Sweden, North Germany, Holland, and so forth, that any nation at the present time comprehended the question of dealing with fish in so thorough, excellent, and scientific a spirit as the United States."

The conference papers, with the discussions, have all been printed, and, together with a series of illustrated popular hand-books, the reports of the juries, and the prize essays, will make up a very important contribution to the literature of fish and fisheries, making about twelve volumes octavo. The catalogue of the exhibition is in itself a small cyclopedia of fisheries, the account of the exhibit of each country being prefaced by a description of its fisheries by some expert. The establishment of a literary bureau, in charge of Mr. Trendell, under whose direction the publications were issued, was an important advance in exhibition administration.

The juries began their work early in June, and continued their activity about two months. A certain amount of jury work was done at a later period, even after the official announcement of the awards—a kind of jury work which seems exceedingly desirable that exhibitions should avoid in the future, if the dissatisfaction still being manifested in England is to be taken as a criterion. The United States was well represented on the juries by Messrs. Earll, Clark, Collins, McLellan, and Hansmann. Mr. E. T. Russell, of Boston, and Mr. Romyn Hitchcock, of New York, who were at that time in London, also served on juries, and Mr. Goode acted as one of the special jury upon prize essays.

The success of the participation of the United States was greatly increased by the fact that so many experts were employed upon its staff, and were constantly in attendance to explain and give significance to the collections—Captain Collins in everything relating to sea fisheries, vessels, and boats; Mr. Earll in fish-culture and the lake fisheries; Dr. Bean in marine zoology; Captain Chester in whaling and sealing; Mr. Clark in fishery products; Lieutenant McLellan in life-saving apparatus; Mr. Hansmann in light-house affairs; Mr. Wood in angling and fine tackle; and Sergeant Mitchell in the work of the Weather Bureau. No such attempt was made by any of the other countries, but its success was so manifest that it is hoped that it may serve as a precedent in future exhibitions.

The presence of these specialists was also important in connection with the work on the official report upon the exhibition and on the present state of the fisheries of Europe, which is now being prepared in accordance with the provision of the act of Congress directing our participation, and which I shall have the honor of submitting within a few months. This report, in addition to the narrative and descriptive part and a general review of European fishing, written by Mr. Goode, will contain special reports by Mr. Earll, upon European fish-culture and the herring and sardine fisheries; by Captain Collins, upon trawl-net fishing, the cod and mackerel fisheries of Europe, and upon fishing vessels and boats; by Mr. Clark, upon the European methods of preparing fishery products and upon the world's commerce in fishery products; by Mr. Cox, upon the English fish trade; by Mr. Hitchcock, upon the scientific apparatus; and by Lieutenant McLellan, upon life-saving appliances.

During the exhibition Mr. Earll visited the Scotch herring-fisheries and the fish-cultural establishment of Sir James Maitland at Stirling, and Captain Collins visited various fishing stations upon the south coast of England, having during a previous visit, at the close of the Berlin Exposition, made a trip upon a Grimsby trawling cutter and studied the trawl-net fishery from a practical standpoint. Mr. Goode's attention, in his leisure time, was, by my direction, devoted chiefly to studying methods of museum management in the great establishments of England; he also made a flying trip to Paris to study the museum methods there, having three years previously visited those of Germany and Italy. Dr. Bean visited the natural-history museums of Liverpool, London, Paris, Geneva, Vienna, and Berlin, to make certain comparisons required in connection with the fishery work.

An international anglers' tournament was held June 11th at Welsh Park, Hendon, under the direction of the Fishing Gazette. On this occasion Mr. Reuben Wood won two of the prizes, (1) for amateur fly-casting with single-handed fly rod, and (2) for amateur fly-casting with a salmon rod, the distance cast in the first instance being 72½ feet, in the latter 108 feet, the wind being considered an unfavorable one. On the 4th of July a trial of life-saving appliances took place in the Serpentine, Hyde Park, in which several American devices proved satisfactory.

The exhibition was formally closed October 30th by the Prince of Wales, and the work of packing the collections for shipment was at once taken up by Messrs. Earll, Chester, and Cox, the other members of the party having returned to their posts in Washington before the close of the exhibition; and before the end of the year the entire collection, in all between 500 and 600 tons, cubic measurement, had been returned to Washington, and the work of setting it up in the permanent fisheries gallery of the National Museum had been begun. Many important accessions to the collection were received during the exhibition, chiefly

by exchange, prominent among which were collective exhibits from Greece, Spain, India, Sweden, and China; an Irish currack from the Marquis of Hamilton; illustrations of the net-maker's art, from Mr. W. B. Tegetmeier; a Danish vessel model, from Mr. Arthur Feddersen, of Viborg; &c. A considerable collection of fish-cultural appliances was given to the new National Fisheries Museum at South Kensington, in exchange for objects from India and China.

The prize list, as far as it can be tabulated from published official announcements up to April 1, 1884, stands as shown in the following table. Comment is unnecessary, except to remark that the United States has no reason to complain of its treatment at the hands of the juries, the acknowledgment of our participation in the substantial form of medallic awards being even greater than we had hoped for.

Eighteen gold medals and four silver ones were given to the Fish Commission, and one gold medal to the National Museum.

In addition to the medals and diplomas tabulated below there were received seven special money prizes, in value aggregating £65 sterling, or $325, and seventeen diplomas of honor, given for "special services rendered" in connection with the exhibition.

No.	Name of country.	Gold.	Silver.	Bronze.	Diplomas.	Total.
1	United States	50	47	30	24	151
2	Norway	29	70	40	7	146
3	Sweden	27	36	40	19	122
4	Canada	17	15	6	4	42
5	New South Wales	11	9	4	1	25
6	Newfoundland	10	9	4	3	26
7	Spain	9	17	13	3	42
8	Netherlands	8	11	6	5	30
9	Russia	7	21	19	6	53
10	India	4	5	4	2	15
11	Italy	4	3	2	.....	9
12	France	3	6	8	3	20
13	Denmark	3	2	9	2	16
14	China	2	3	.....	1	6
15	Tasmania	1	4	.....	.....	5
16	Greece	1	3	.....	.....	4
17	Bahamas	1	1	1	1	4
18	Chili	.....	2	2	.....	4
19	Germany	.....	1	3	1	55
20	Belgium	.....	1	3	1	5
21	Jamaica	.....	1	2	5	8
22	Straits Settlements	.....	1	2	.....	3
23	Austro-Hungary	.....	1	.....	.....	1
24	Tunis	.....	1	.....	.....	1
25	Ceylon	.....	1	.....	.....	1
26	Japan	.....	.....	2	1	3
	Total	184	271	200	89	747
	England, Ireland, and Scotland*	155	253	212	128	748
	Grand total	342	524	412	217	1,495

*Of the 155 gold medals awarded exhibitors of the United Kingdom, England received 110, Scotland 38, Ireland 7.

An International Exhibition of Agriculture and the Fisheries was held at Aalborg, Denmark, in June. In response to an invitation from the authorities, and with my approval, Mr. Goode sent over a number of objects which he had no room to display in London. The result was the award of a silver medal to the U. S. Fish Commission, and ten bronze medals to special exhibitors, chiefly of fishery products.

A detailed list of prize-winners both at London and Aalborg is given in the appendix to this report.

In closing the account of the fisheries exhibition it seems proper to mention by name the persons who contributed to its success, since in every instance their efforts were exerted far more strenuously than was required by their official duty. The following officers of the Musuem, some of whom were also on the staff of the exhibition, were directly engaged in selecting, labeling, and installing the collections: Mammals, Frederick W. True; aquatic birds, Robert Ridgway; aquatic reptiles and batrachians, Dr. H. C. Yarrow; fishes, Dr. Tarleton H. Bean; mollusks, Lieut. Francis Winslow, U. S. N.; aquatic invertebrates, fishing grounds, and scientific research, Richard Rathbun; apparatus and products of fishing, W. V. Cox and A. Howard Clark; boats and vessels, Capt. J. W. Collins; aboriginal fishing apparatus, J. King Goodrich; fish-culture, R. Edward Earll.

Mr. Henry W. Elliott, Mr. A. Z. Shindler, and Mr. Leopold Moeller, artists; Mr. T. W. Smillie, photographer; Messrs. Hornaday, Marshall, and Lucas, taxidermists; Messrs. Joseph and William Palmer and Mr. Hendley, modelers; Messrs. Hawley and Sweeney, preparators; and Mr. Curet, printer, also contributed largely to the success of the collection by their enthusiastic co-operation.

The co-operation of Messrs. Ferguson, McDonald, Atkins, Stone, and Clark in the preparation of the fish-cultural work was of great importance, as was also that of Messrs. Thomas Donaldson, E. G. Blackford, Barnet Phillips, W. A. Wilcox, A. R. Crittenden, James G. Swan, C. W. Smiley, and Henry Horan in various matters connected with the administration.

The important services of all those so briefly mentioned here will be described more fully in the special report on the exhibition; they are here referred to in order that formal acknowledgment may be made for their energetic and disinterested services in behalf of our display at the London Exhibition.

General E. H. Merritt and Col. L. G. Mitchell, consul-general and vice-consul of the United States in London, and Mr. W. J. Hoppin, secretary of legation, and Mr. William Wesley, should also be mentioned as having rendered important aid.

The official catalogue of the United States sections forms Bulletin 27 of the National Museum. It has been printed in parts, six of which were issued during the exhibition, viz:

	Pages.
A. Preliminary catalogue and synopsis	107
B. Collection of economic crustaceans, worms, echinoderms, and sponges, by Richard Rathbun	31
C. Aquatic and fish-eating birds, by Robert Ridgway	46
D. The whale fishery and its appliances, by J. T. Brown	116
E. Collection of fishes, by Tarleton H. Bean	124
F. Economic mollusca, apparatus and appliances used in their capture and preparation for market, by Lieut. Francis Winslow	81

Other parts will soon follow, viz:

G. Apparatus of scientific research, by Richard Rathbun.
H. Aquatic mammals, by Frederick W. True.
I. Fish-culture and its appliances, by R. E. Earll.
J. Fishing boats and vessels, by Joseph W. Collins.
K. Apparatus of fishing, by A. Howard Clark.

9.—PUBLICATIONS IN 1883.

Reports.—The Report for 1880 (volume viii), two-thirds of which had been previously put in type, was completed early this year, the entire volume, with indexes and illustrations, being approved June 30. During the summer the press-work and binding were attended to, and the volume was ready for distribution October 31.

The Report for 1881 (volume ix) was pushed rapidly forward, and by the close of the year it was all in type except about 100 pages.

Bulletins.—Of the Bulletin for 1882, 160 pages had been printed and distributed in signatures in 1882. The remainder of the volume, consisting of 467 pages in all, was put in type and distributed in signatures between January and July. The edition ordered by Congress was then printed, and the bound volumes were ready for distribution August 27.

The volume for the current year was commenced immediately on the completion of the preceding volume (July 1st), and on December 31st the entire volume was in type. The signatures were distributed to about two hundred correspondents as fast as issued, the closing signatures, containing the index, having been mailed January 4th, 1884.

Pamphlets.—The number of copies of the Reports and Bulletins for distribution being comparatively limited, pamphlet editions of many of the papers were issued for general distribution. During the current year the following were issued:

GOODE, G. BROWN. Materials for a history of the swordfishes.

[From Report for 1880, pp. 287–392, pl. 24, index.]

GOODE, G. BROWN, JOSEPH W. COLLINS, R. E. EARLL, and A. HOWARD CLARK. Materials for a history of the mackerel fishery.

BAIRD, SPENCER F. Inducements offered fishermen to furnish shad eggs for the U. S. Commission of Fish and Fisheries.

[From Bulletin for 1882, pp. 389–391.]

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

[London Exhibition, part A, pp. 107.]

RATHBUN, RICHARD. Collection of economic crustaceans, worms, echinoderms, and sponges.

[London Exhibition, part B, pp. 31.]

RIDGWAY, ROBERT. Catalogue of the aquatic and fish-eating birds exhibited by the U. S. National Museum.

[London Exhibition, part C, pp. 46.]

WINSLOW, FRANCIS. Catalogue of the economic mollusca and the apparatus and appliances used in their capture and preparation for market. Exhibited by the U. S. National Museum.

[London Exhibition, part D, pp. 86.]

BROWN, JAMES TEMPLE. The whale fishery and its appliances.

[London Exhibition, part E, pp. 116.]

BEAN, TARLETON H. Catalogue of the collections of fishes exhibited by the U. S. National Museum.

[London Exhibition, part F, pp. 124.]

EARLL, R. EDWARD. The Spanish mackerel, *Cybium maculatum* (Mitch.) Ag.; its natural history and artificial propagation, with an account of the origin and development of the fishery.

[From Report for 1880, pp. 395-426.]

MCDONALD, MARSHALL. Specifications for the superstructure of the fishway proposed for the Great Falls, Potomac River, Maryland, pp. 3.

BAIRD, SPENCER F. Report of the Commissioner for 1880. A.—Inquiry into the decrease of food-fishes. B.—The propagation of food-fishes in the waters of the United States.

[From Report for 1880, pp. xvii-xlvi.]

POTTS, EDWARD. Freshwater sponges: what, where, when, and who wants them.

[From Bulletin for 1883, pp. 389-391.]

Carp publications.—During the year 1883 two editions of Hessel's pamphlet entitled "The carp and its culture in rivers and lakes" were issued for general distribution.

An additional pamphlet was prepared by Mr. Charles W. Smiley, entitled "Carp and Carp ponds," containing: (1) Answers to 118 questions relative to German carp; (2) directions concerning the construction of carp ponds. This pamphlet of 16 pages was the result of an effort to put into the form of questions and answers the principal facts which the correspondence of the Commission had shown that farmers and others desired to have in reference to carp. The directions for constructing ponds were accompanied by 7 large illustrative figures.

Later in the season a pamphlet of 32 pages by the same author was issued, entitled "Notes on the edible qualities of German carp and hints about cooking them." This was prepared from replies from several hundred circulars, which were sent to all parts of the country, addressed to persons who had received carp in 1879 or 1880. The testimonies of several hundreds of these were given verbatim, and the general

tenor of their statements was highly satisfactory, indeed fully up to the claims which the Commission had from time to time made concerning the carp as a food-fish. A few criticisms and uncomplimentary remarks were elicited by this correspondence, but in nearly every case there was internal evidence that the critics had undertaken to eat carp during the spawning season, had spoiled the fish in cooking, or that the fish had been kept in very foul water without efforts being made to purify the flesh thereafter.

These publications are forwarded to correspondents requesting them, and in reply to letters of inquiry, thus saving a large amount of letter-writing.

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

10.—THE WOOD'S HOLL STATION.

One of the most important directions in which the work of the Commission can be extended is in the multiplication, by artificial propagation, of the sea fishes, which constitute by far the most valuable element of the American fisheries in general. In this, we of course include the shell-fish and lobster. In the report for 1878 will be found a full account of the first experiments in this direction made by the Commission upon the cod at Gloucester, Mass. The results were very satisfactory as far as they went, and it was shown that all the various problems in the case could readily be solved with favoring circumstances. Several difficulties, however, existed at Gloucester; first, the absence of facilities for penning up the live fish until their eggs became ripe and ready for impregnation; second, the impurity of the sea-water, which caused a constant deposit of mud upon the eggs, destroying them in large part; third, the inclemency of the winter, involving the stoppage of the circulation of the water by freezing, and the killing of the fish if kept in floating cars at the surface; fourth, the inability to find, at reasonable cost, a suitable wharf or building in which the work could be prosecuted.

In spite of all these obstacles, however, a large number of codfish were hatched out and placed in Gloucester Harbor, without much expectation of hearing further from them. The fish used for the purpose were the gray variety, believed to come from the off-shore banks to the coast of the mainland for the purpose of spawning, the winter season being the period of this migration. During the following summer, however, small cod of the gray or off-shore variety were met with around the wharves in the harbor, and at once attracted attention, such an occurrence being quite unheard of before. Again, the next year, these fish were found outside of the harbor, and of considerably larger size,

fairly representing the second year of growth. The third year they were taken of a still larger size, and farther north along the coast, the fish of this school being universally known as "Fish Commission cod."

The codfish is, of course, taken freely on the Massachusetts coast during the summer season; but it is for the most part the rock or reddish cod, and not the gray or Banks cod, and is not of much commercial importance.

Subsequent to 1878 a careful search was prosecuted to find a location for the construction of a permanent hatching establishment for the marine fish; Noank, Stonington, Newport, Provincetown, and Wood's Holl passing successively in review. The last-mentioned place, however, was the only one that combined the necessary requirements to any reasonable degree.

The facilities heretofore furnished the Commission by the Light-House Board on its wharf (at Wood's Holl) were found entirely inadequate to the occasion, especially as the water of the Little Harbor was not satisfactory; a location was, however, found on a rocky point on the Great Harbor which it was believed would answer all the necessary purposes.

The river and harbor bill of the spring of 1882 included an appropriation for the construction of a harbor of refuge at Wood's Holl, and the Chief Engineer of the Army sanctioned some special adaptations of the plan of construction to meet the wants of the Fish Commission.

The projecting point in question, which it was desired to utilize as a station, formed part of a plot of ground belonging to Messrs. Isaiah Spindel & Co., of Wood's Holl, who offered it at the sum of $7,250. For various reasons it was thought best to raise this amount by private subscription, the money to be paid and the land presented to the United States in the event of the actual construction by the Government of the pier and breakwater referred to. The money was accordingly furnished by the following parties:

Old Colony Railroad Company	$2,500
John M. Forbes	1,000
Alexander Agassiz	500
Johns Hopkins University	1,000
Princeton College	1,000
Williams College	500
Isaiah Spindel & Co	500
Mrs. Robert L. Stuart	250

The colleges in question and Mr. Agassiz made their contribution with the understanding that, as far as possible, they were each to be allowed to send one specialist to the station for the purpose of carrying on scientific research.

In addition to these contributions, Mr. Joseph S. Fay, of Wood's Holl, presented to the United States a very valuable shore line, extending from the lot of Isaiah Spindel & Co., just referred to, to the grounds of the Pacific Guano Company; thus assuring a long stretch of shore where no buildings likely to be detrimental to the business of the Commission could be erected.

By direction of the Attorney-General of the United States, Hon. George P. Sanger, United States district attorney for Massachusetts, carefully investigated the titles of Messrs. Fay and Isaiah Spindel & Co., and pronounced them to be valid.

The property was then conveyed to two trustees, C. F. Choate, president of the Old Colony Railroad Company, and Mr. J. Malcolm Forbes, with the understanding, as stated, that whenever the work on the pier was formally begun the shore line should be transferred to the United States for the purposes of the U. S. Fish Commission, the value of the ground thus acquired being not less than $15,000. The transfer being made, the whole transaction was submitted again to the Attorney-General and received his sanction.

In the mean time, an appropriation of $25,000 had been made by Congress to commence the construction of the necessary buildings, and the plans of Mr. Robert H. Slack, of Boston, being selected, a contract was made with Mr. W. R. Penniman, of South Braintree, Mass., for the erection of the first building. Ground was broken in August, 1883, and by the end of the year the building was under roof.

Concurrently with the work on the foundations of the quarters building, the dredging of the trenches for building the piers of the engineer work was carried on, although, owing to the inefficiency of the dredge, not much work was accomplished during the year.

The series of buildings desired for the Commission was as follows:

1. A building available for offices, and for storage of boats and other property, and for hatching purposes; also for quarters for the persons occupied at the establishment during the several seasons of the year; this to include the necessary accommodations for the mess.*

As there was no assurance that another appropriation would be made by which to complete the series, this building was arranged to supply all requirements on a limited scale, and the expenditure of the appropriation was limited to this building and the next.

2. A reservoir with suitable pumping facilities, in which could be stored salt and fresh water, and from which it could be distributed to different parts of the establishment.

3. A fish-hatching building, where the work of fish propagation could be conducted, and which should also furnish facilities for the collateral operations authorized by Congress.

4. A coal shed, where a supply of coal for the steamers of the commission could be kept.

5. A storehouse for keeping supplies.

It was expected to utilize the pier and breakwater to be constructed

* Heretofore, in order to meet the needs of the party working at the summer station, a mess had been organized which was furnished accommodations in one of the hired buildings. This was a self-supporting affair, managed by a caterer who paid all expenses for provisions and service from the mess fund, which was kept up by the payment of $1 per day by each member.

by the engineer department, by establishing it as a marine station for the accommodation of the Albatross, Fish Hawk, Lookout, &c., and for basins in which to keep the fish, lobsters, &c., undergoing treatment.

The building for the quarters was the first to be constructed, in view of the impossibility of obtaining the necessary accommodations in the village of Wood's Holl. The place is without any hotel, and has but a single boarding-house, which is generally filled in the summer season by regular boarders. During 1881, 1882, and also 1883, the Commission was obliged to scatter all over the village, renting three buildings for offices and other purposes, and obtaining single rooms wherever they could be had. It was considered of the utmost importance in the interest of economy and of efficiency to concentrate all this force, so that the business of the Commission could be properly transacted; and it is hoped that the report for 1884 will chronicle the completion of this work, and the successful commencement of the fish-hatching and other operations.

The work at the station for the year was quite similar to that of 1882, except that by means of the Albatross a much wider range of research was prosecuted, as will be seen in the special paragraph on that vessel.

As usual, a large number of scientific specialists, partly connected with the Commission and partly volunteers from the colleges of the country, were present; and great additions were made to our knowledge of the animal forms of the sea, and their mutual relationships and dependencies. As heretofore, collections in great magnitude were obtained, and taken to Washington at the close of the season, the duplicates, after supplying the National Museum, to be made up in sets for distribution, on the indorsement of members of Congress, to the various colleges and academies throughout the country.

This subsidiary work of the Commission has proved to be very acceptable to all persons interested, bringing to educational institutions in the far West the same facilities for instruction in marine natural history as were previously posssed only by those situated near the seaboard.

I refer to the report of the Commissioner for the year 1882 for further and minuter details in regard to the early history of the project for a permanent station, and the steps leading to its realization.

11.—VISITS FROM FOREIGN SPECIALISTS.

On the 5th of March Capt. G. M. Dannevig, of Arendal, Norway, visited Washington for the special purpose of ascertaining the methods adopted by the U. S. Fish Commission in hatching cod, with a view to introducing them into his country where (particularly on the southern coast) cod and other fishes appear to be rapidly diminishing. Every facility was given him for studying the subject, and after his return to Norway he made a quite successful experiment. He used the

Clark hatching-box in preference to other apparatus brought to his attention.

Mr. Henry Grosjean was sent by the French department of agriculture to study up several subjects. He paid particular attention to the work of the Fish Commission, and on his return to France prepared an elaborate report to the minister.

12.—PROVISION FOR THE EVENT OF DISABILITY OF THE COMMISSIONER.

In view of there being no provision of law by which the functions of the Commissioner of Fish and Fisheries could be exercised, in case of his absence or disability, an act was passed by Congress, and approved March 3, 1883, to remedy this defect.

In pursuance of this authority Mr. T. B. Ferguson was designated as Assistant Commissioner on the 7th of July, and a letter was transmitted to the Secretary of the Treasury notifying him of the fact.

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

13.—THE INVESTIGATION OF THE MENHADEN FISHERY BY THE SENATE COMMITTEE.

The appointment of a subcommittee of the Senate to investigate the subject of the menhaden fishery was chronicled in the report of 1882, and a résumé given therein of what was accomplished, leaving the work to be continued in 1883.

The investigation was appointed to begin between the 20th of June and the 4th of July, with sessions at Atlantic City, Asbury Park, Long Branch, and Brighton Beach, and the Commissioner was invited to accompany the committee either personally or by proxy.

Mr. Marshall McDonald was accordingly designated to represent the Fish Commission, and on July 11 wrote from Cape May that the investigation had commenced, the three Senators being present. Senator Sewell and several representative men of New Jersey were also there to testify. The committee had asked for the use of the Fish Hawk, but as she was engaged in Spanish mackerel and oyster work it was not found possible to divert her from that duty. Later the committee proceeded to Portland, Me., where the last session was held July 25. On the way to Portland several sessions were held in Boston. On the 4th of October Senator Lapham applied for the steamer Lookout, with which to reopen the investigation in the Chesapeake. He was accordingly met by Mr. McDonald at Fortress Monroe October 12, where they established their headquarters, and, with the aid of the Lookout, visited the menhaden factory of Darby & Smithers at Back River, and other points. The testimony taken by the committee has been published by order of the Senate.

14.—THE FISHERY CENSUS OF 1880 AND ITS RESULTS.

As stated in preceding reports, an arrangement was made with General Francis A. Walker, Superintendent of the Tenth Census, in 1879, by which an investigation of the fisheries of the United States was undertaken as the joint enterprise of the U. S. Fish Commission and of the Census Bureau. It was decided that this investigation should be as exhaustive as possible, and that both the U. S. Fish Commission and the Census should participate in its preparation. The making up of a statistical and historical account of the fisheries, in general, to be published in the report of the Superintendent of the Census, was from the first the main object, but in connection with this, exhaustive investigations into the methods of the fisheries, the location and extent of the fishing grounds, and the natural history of useful marine animals were carried on.

The details of the proposed research were drawn up before the beginning of the work, and were published in an octavo pamphlet of fifty-four pages, entitled "Plan of Inquiry into the History and Present Condition of the Fisheries of the United States. Washington, Government Printing Office, 1879," and was reproduced in the 1880 Report, Part VIII, pp. 3–52.

The expense of the field-work from July 1, 1881, was for the most part borne by the Census, together with a large amount of compilation work carried on by clerks detailed from the Census Office in Washington. That involved in the preparation of the report, final tabulation of statistics of production, and preparation of illustrations has been mainly at the cost of the Fish Commission. Since February, 1881, Mr. Goode's connection with the Census Office has been purely nominal, and his services in the preparation of the reports and in connection with their publication have been rendered without compensation, in addition to his regular duties as assistant director of the National Museum. In the same manner a large share of the most important work upon special parts of the report has been the volunteer labor of officers of the National Museum and Fish Commission, in addition to their regular duties. A number of employees of the Fish Commission were detailed from time to time for special work upon this report, for periods varying from four months to two years.

The participation of the Census Office and the Commission of Fish and Fisheries has involved the expenditure of probably nearly equal amounts of money, and the division of the results, so far as they are represented in reports ready for the printer, has been arranged to the satisfaction of both. The extent of the material collected has, however, been much greater than was anticipated, and the portion assigned to the Fish Commission being too bulky for publication in the annual reports, application was made to Congress for permission to print as a separate special report an illustrated work in quarto upon the Food-Fishes and Fisheries of the United States.

This permission was granted in a joint resolution, which passed the Senate July 16, 1882.*

The manuscript of the entire report is for the most part ready for the printer, and several hundred drawings for the illustrations are finished. Part I was placed in the hands of the printer in August, 1882, and would have been published during the present year but for the absence of Mr. Goode in England in the performance of other duties in connection with the Commission. The contents of these reports will approximately be as follows, though it is probable that other topics may be added to the discussion before the work is completed:

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

PART I.—The Natural History of Useful Aquatic Animals.
II.—The Fishing-Grounds.
III.—The Fishing Towns, containing a geographical review of the Coast, River, and Lake Fisheries.
IV.—The Fishermen.
V.—The Apparatus of the Fisheries and Fishing Vessels and Boats.
VI.—The Fishery Industries, a discussion of methods and history.
VII.—The Preparation of Fishery Products.
VIII.—Fish-Culture and Fishery Legislation.
IX.—Statistics of Production, Exportation, and Importation. Summary Tables.
X.—The Whale Fishery; a special monograph.
XI.—A Catalogue of the Useful and Injurious Aquatic Animals and Plants of North America.
XII.—A List of Books and Papers relating to the Fisheries of the United States.
XIII.—A General Review of the Fisheries, with a statistical summary.

The report prepared for the Superintendent of the Census, the manuscript of which is now for the most part in his possession, is divided into the following sections:

A REPORT UPON THE STATISTICS OF THE FISHERIES AND FISH TRADE OF THE UNITED STATES.

Introduction (giving a comprehensive abstract of the matter contained in the quarto report referred to above).
PART I.—A Review of the Fisheries of the Atlantic Seaboard, with statistics of production and manufactures.
II.—A Review of the Fisheries of the Pacific Coast, with statistics of production and manufactures.
III.—A Review of the Fisheries of the Great Lakes, with statistics of production and manufactures.
IV.—A Review of the River Fisheries of the United States. (Prepared by C. W. Smiley.)
V.—A Review of the Consumption of Fish by Counties, with an estimate of the extent and value of the inland fisheries. (Prepared by C. W. Smiley.)

* For text of bill, see Report U. S. F. C., 1882, Part X, p. xlvii.

PART VI.—A Review of the Fish Trade of cities of the United States having a population of more than 10,000 in 1880. (Prepared by C. W. Smiley.)

VII.—Statistics of Importation and Exportation of Fishery Products from 1730 to 1880.

VIII.—List of the Fishing Vessels of the United States in 1880, giving tonnage, value, number of crew, name of owner, branches of fisheries engaged in, together with other important details.

IX.—Monograph of the Seal Islands of Alaska. By Henry W. Elliott. (Already in type; 171 pages. 4to.)

X.—Monograph of the Oyster Fisheries. By Ernest Ingersoll. (Already in type; 251 pages.)

This series includes all compilations from circulars, and the results of the work performed by clerks detailed from the Census Office, together with much derived from the archives of the Fish Commission.

The first three sections are mainly made up from the material collected by the special agents in the field, and the form is as nearly as possible that in which it was originally collected; much, however, has been added from the archives of the Commission.

By the plan just detailed the statistical matter gathered by the joint efforts of the two organizations is assigned to the Census, together with a sufficient amount of descriptive and explanatory text to make the statistics fully intelligible, while the descriptive, historical, and natural history papers are taken by the Fish Commission, these being enriched by a sufficient amount of statistical detail to render them as useful as possible for the class of readers and students for whom they are intended.

The statistical results of the investigations have already been published in a preliminary way. A series of special statistical tables appeared in the bulletins of the Census Office, as follows:

(1) Census Bulletin No. 176.—[Preliminary report upon the Pacific States and Territories] prepared by Mr. Goode from returns of Special Agents Jordan, Swan, and Bean. Dated May 24, 1884. 4to. pp. 6 (+2).

(2) Census Bulletin No. 261.—Statistics of the Fisheries of the Great Lakes. Prepared by Mr. Frederick W. True from notes of Special Agent Kumlien. Dated September 1, 1881. 4to. pp. 8.

(3) Census Bulletin No. 278.—Statistics of the Fisheries of Maine. Prepared by Mr. R. E. Earll from his notes and those of Mr. C. G. Atkins. Dated November 22, 1881. 4to. pp. 47 (+ 1).

(4) Census Bulletin No. 281.—Statistics of the Fisheries of Virginia. Prepared by Col. Marshall McDonald. Dated December 1, 1881. 4to. pp. 8.

(5) Census Bulletin No. 291.—Statistics of the Fisheries of New Hampshire, Rhode Island, and Connecticut. Prepared by Mr. A. Howard Clark. Dated April 5, 1882. 4to. pp. 7 (+1).

(6) Census Bulletin No. 295.—Statistics of the Fisheries of Massachusetts. Prepared by Mr. A. Howard Clark from returns of Special Agents Wilcox, Clark, True, Collins, and Atwood. Dated March 1, 1882. 4to. pp. 35 (+ 1).

(7) Census Bulletin No. 297.—Commercial Fisheries of the Middle States. Prepared by Mr. R. E. Earll and Col. M. McDonald. Dated June 5, 1882. 4to. pp. 14. (This bulletin includes statistics of No. 4. C. B. No. 281.)

(8) Census Bulletin No. 298.—Commercial Fisheries of the Southern Atlantic States. Prepared by Mr. R. E. Earll and Col. M. McDonald. Dated June 5, 1882. 4to. pp. 18.

In all 148 pages, quarto.

In addition to these, certain special tables have appeared:

(9) Statistical Table.—Statistics of the Fisheries of the United States in 1880. [Prepared by Messrs. Goode and Earll from the reports of special agents.] Printed in Compendium of the Tenth Census, p. 88. pp. —. Republished in Bulletin of the U. S. Fish Commission, vol. iii, 1883, pp. 270–271, and in Preliminary Catalogue, International Fisheries Exhibition, January, 1883, p. 5.

(10) Statistical Table.—Table showing by States the quantity of Spanish mackerel taken in 1880, and the total catch for the United States. By R. Edward Earll. Report U. S. Fish Commission. Part VIII, 1880, p. 416.

(11) Statistical Summary.—Statistics of the Davis Strait Halibut Fisheries. By Newton P. Scudder. Report U. S. Fish Commission. Part VIII, pp. 190–192.

(12) Statistical Summary.—Statistics of the Swordfish Fishery. By G. Brown Goode. Report U. S. Fish Commission. Part VIII, pp. 361–367.

(13) Statistical Summaries.—Statistics of the Mackerel Fishery in 1880. By R. Edward Earll. Report U. S. Fish Commission. Part IX, pp. [124]-[127].

[Statistics of the Mackerel Canning Industry.] By R. Edward Earll. Ibid, p. [131].

Statistics of the inspection of mackerel from 1804 to 1880. By A. Howard Clark. Ibid, pp. [162]-[213].

Vessels in the Mackerel Fishery in 1880. Ibid, p. [418].

Catch of mackerel by Americans in Canadian waters, 1873-'81. Ibid, p. [430].

(14) Introduction to Section B., U. S. Catalogue International Fishery Exhibition, London. (Collection of Economic Crustaceans, Worms, Echinoderms, and Sponges.) By Richard Rathbun. pp. [3]-[20]. Crabs, p. [3]; Lobsters, p. [6]; Crayfish, p. [10]; Shrimps and Prawns, p. [11]; Sponges, p. [18]; &c.

(15) Introduction to Section D., U. S. Catalogue International Fishery Exhibition. (Catalogue of the Economic Mollusca and the apparatus and appliances used in their capture and preparation for market, exhibited by the U. S. National Museum.) By Lieut. Francis Winslow, U. S. N. pp. [3] to [58]. Aggregate table of production, p. [3]; special tables and statistical tables throughout.

(16) Introduction to Section E., U. S. Catalogue International Fishery Exhibition. (The whale fishery and its appliances). By James Temple Brown. pp. [3]-[25].

(17) Statistics of the Whale Fishery. By A. Howard Clark, in the preceding, pp. [26]-[29].

(18) A review of the fishery industries of the United States, &c. By G. Brown Goode. An address at a conference of the International Fishery Exhibition, June 25, 1883. 8vo., pp. 84. Numerous statistical statements, summaries, and tables.

(19) Administrative Report.—Method and results of an effort to collect statistics of the fish trade and consumption of fish throughout the United States. By Charles W. Smiley. Bulletin U. S. Fish Commission, vol. ii, 1882, pp. 247-252.

Two special reports have also been published as follows:

(20) A monograph of the Seal Islands of Alaska. By Henry W. Elliot. 4to., illustrated. pp. 172. An edition of this report with substitutions on pp. 102-109 was also issued as a special bulletin of the Fish Commission, No. 176.

(21) The Oyster Industry. By Ernest Ingersoll. 4to., illustrated. pp. 252.

Part I of the special report on the Food-Fishes and Fishery Industries of the United States, ordered by Congress July 16, 1882, has been put in type, as has been stated, and at the end of the year was awaiting the completion of the engraved plates. This volume, devoted to the natural history of the useful aquatic animals, contains 895 pages quarto. The character of its contents may best be indicated by the following analysis:

PART I.—MAMMALS.

A. Whales and porpoises. By G. Brown Goode
B. Seals and walruses. By Joel A. Allen.
C. Habits of the fur-seal. By Henry W. Elliott.
D. Manatees and the arctic sea-cow. By Frederick W. True.

PART II.—REPTILES AND BATRACHIANS. By Frederick W. True.

E. The alligator and crocodile.
F. Tortoises, turtles, and terrapins.
G. The amphibians.

PART III.—FISHES. By G. Brown Goode. With discussions of species, by David S. Jordan and Tarleton H. Bean, notes on the fishes of the Gulf of Mexico by Silas Stearns, and contributions from Joseph W. Collins, N. E. Atwood, Marshall McDonald, R. Edward Earll, Ludwig Kumlien, and other authorities.

H. The file-fishes, pipe-fishes, and anglers.
I. Flat-fishes and flounders.
J. The cod family and its kindred.
K. Wolf-fishes, sculpins, and wrasses.
L. Mackerel and its allies.
M. The tilefish family and others.
N. The drum family.
O. The sheepshead, bass, bream, perch, &c.
P. Barracuda, mullet, pike, and mummachog.
Q. The salmon tribe.
R. The herring and the menhaden.
S. The shad and the alewives.
T. Families related to the Clupeidæ.
U. Carp, suckers, catfish, and eels.
V. Sturgeons, skates, sharks, and lampreys.

PART IV.—MOLLUSKS.

W. Mollusks in general. By Ernest Ingersoll.
X. The life history of the oyster. By John A. Ryder.

PART V.—CRUSTACEANS, WORMS, RADIATES, AND SPONGES. By Richard Rathbun.

Y. Crustaceans.
Z. Worms.
Za. The radiates.
Zb. The poriferans.

This constitutes the first volume of this series and will be illustrated by 432 engravings of aquatic animals, arranged upon 277 plates.

Part II of the same work, consisting of a treatise upon the fishing-grounds of North America, by Richard Rathbun and Capt. Joseph W. Collins, has been sent to the printer.

Nothing has been printed by the Census Office excepting a summary table of the fisheries in the Compendium published during the present year, which is here reproduced:

Statistics of the fisheries of the United States in 1880.

	States and Territories.	Grand total.			Persons employed.		Apparatus and capital.		
							Vessels.		
		Persons employed.	Capital invested.	Value of products.	Fishermen.	Shoresmen.	Number.	Tonnage.	Value.
		No.	*Dollars.*	*Dollars.*	*No.*	*No.*			*Dollars.*
	The United States	131,426	37,955,349	43,046,053	101,684	29,742	6,605	208,207.82	9,357,282
	New England States	37,043	19,037,607	14,270,393	29,838	7,205	2,066	113,602.50	4,562,131
	Middle States, exclusive of Great Lake fisheries	14,981	4,426,078	8,676,579	12,584	2,397	1,210	23,566.93	1,382,000
	Southern Atlantic States	52,418	8,951,722	9,602,737	38,774	13,644	3,014	60,886.15	2,375,450
	Gulf States	5,131	545,584	1,227,544	4,382	749	197	3,009.86	308,051
	Pacific States and Territories	16,803	2,748,383	7,484,750	11,613	5,190	56	5,463.42	546,450
	Great Lakes	5,050	1,345,975	1,784,050	4,493	557	62	1,768.87	183,200
1	Alabama	635	38,200	119,275	545	90	24	317.20	14,585
2	Alaska	6,130	447,000	2,661,640	6,000	130			
3	California	3,094	1,139,675	1,860,714	2,089	1,005	49	5,246.80	535,350
4	Connecticut	3,131	1,421,020	1,456,866	2,585	546	201	9,215.95	514,050
5	Delaware	1,079	268,231	997,695	1,662	317	69	1,226.00	51,600
6	Florida	2,480	406,117	643,227	2,284	196	124	2,152.97	272,645
7	Georgia	899	78,770	119,993	809	90	1	12.00	450
8	Illinois	300	83,400	60,100	265	35	3	209.73	8,500
9	Indiana	52	29,300	32,740	45	7	1	21.90	2,500
10	Louisiana	1,597	93,021	302,610	1,300	297	49	539.69	20,821
11	Maine	11,071	3,375,994	3,614,178	8,110	2,961	606	17,632.65	633,542
12	Maryland	26,008	6,342,443	5,221,715	15,873	10,135	1,450	43,500.00	1,750,000
13	Massachusetts	20,117	14,334,450	8,141,750	17,165	2,952	1,054	83,232.17	3,171,180
14	Michigan	1,781	442,665	716,170	1,600	181	36	914.42	98,500
15	Minnesota	35	10,100	5,200	30	5	1	33.59	5,000
16	Mississippi	186	8,800	22,540	110	76			
17	New Hampshire	414	209,465	176,684	376	38	23	1,019.05	51,500
18	New Jersey	6,220	1,492,202	3,176,589	5,659	561	590	10,445.00	545,900
19	New York	7,206	2,620,585	4,380,565	5,650	1,616	541	11,582.51	777,600
20	North Carolina	5,274	506,561	845,695	4,729	545	95	1,457.90	39,000
21	Ohio	1,046	473,800	518,420	925	121	9	359.51	38,400
22	Oregon	6,835	1,181,350	2,781,024	2,795	4,040			
23	Pennsylvania	552	119,810	320,050	511	41	11	321.99	10,500
24	Rhode Island	2,310	596,678	880,915	1,602	708	92	2,502.77	101,850
25	South Carolina	1,005	66,275	212,482	964	41	22	337.32	15,000
26	Texas	601	42,400	128,300	491	110			
27	Virginia	18,864	1,914,119	3,124,444	16,051	2,813	1,446	15,578.08	571,000
28	Washington	744	30,358	181,872	729	15	7	210.62	11,100
29	Wisconsin	800	222,840	253,100	750	70	11	220.25	26,700

Statistics of the fisheries of the United States in 1880.

Apparatus and capital—cont'd.				Value of products by fisheries.							
Boats.		Value of minor apparatus and outfits.	Other capital, including shore property.	General fisheries.	Whale fishery.	Seal fishery.	Menhaden fishery.	Oyster fishery.	Sponge fishery.	Marine salt industry.	
Number.	Value.										
	Dollars.	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dolls.*	*Dolls.*	
44, 804	3, 465, 393	8, 145, 261	17, 987, 413	22, 405, 018	2, 323, 943	2, 289, 813	2, 116, 787	13, 403, 852	200, 750	385, 890	
14, 787	739, 970	5, 038, 171	9, 597, 335	10, 014, 645	2, 121, 385	111, 851	539, 722	1, 478, 900	.....	3, 890	
8, 293	546, 647	674, 951	1, 822, 480	2, 882, 204	.....	.....	1, 261, 385	4, 532, 900	.....	.....	
13, 331	640, 508	1, 145, 878	4, 789, 886	2, 217, 797	408	.....	315, 680	7, 008, 852	.....	.....	
1, 252	50, 173	52, 823	134, 537	713, 594	.....	.....	.....	313, 200	200, 750	.....	
5, 547	404, 695	467, 238	1, 330, 000	4, 792, 638	202, 150	2, 177, 962	.....	10, 000	.....	302, 000	
1, 594	83, 400	766, 200	313, 175	1, 784, 050	.....	.....	.....	.....	.....	.....	
119	10, 215	7, 000	6, 400	74, 325	.....	.....	.....	44, 950	.....	.....	1
3, 000	60, 000	7, 000	380, 000	564, 640	500	2, 006, 500	.....	.....	.....	.....	2
853	91, 485	205, 840	307, 000	1, 341, 314	201, 650	15, 750	.....	.....	.....	302, 000	3
1, 173	73, 585	375, 535	467, 850	383, 887	32, 048	111, 851	256, 205	672, 875	.....	.....	4
839	33, 227	70, 324	113, 080	309, 029	.....	.....	941	687, 725	.....	.....	5
1, 058	28, 508	39, 927	65, 037	426, 527	.....	.....	.....	15, 950	200, 750	.....	6
358	15, 245	18, 445	44, 450	84, 993	.....	.....	.....	35, 000	.....	.....	7
101	2, 000	11, 000	61, 000	60, 100	.....	.....	.....	.....	.....	.....	8
15	1, 650	20, 210	5, 000	32, 740	.....	.....	.....	.....	.....	.....	9
165	4, 800	18, 000	50, 000	192, 610	.....	.....	.....	200, 000	.....	.....	10
5, 920	245, 624	934, 593	1, 562, 235	3, 576, 678	.....	.....	.....	37, 500	.....	.....	11
2, 825	186, 448	297, 145	4, 108, 850	479, 388	.....	.....	11, 851	4, 730, 476	.....	.....	12
6, 749	351, 736	8, 528, 925	7, 282, 600	5, 581, 204	2, 089, 337	.....	61, 769	405, 550	.....	3, 890	13
454	10, 345	272, 920	60, 900	716, 170	.....	.....	.....	.....	.....	.....	14
10	900	3, 760	500	5, 200	.....	.....	.....	.....	.....	.....	15
58	4, 600	1, 600	2, 009	12, 540	.....	.....	.....	10, 000	.....	.....	16
211	7, 780	60, 385	89, 800	170, 834	.....	.....	.....	6, 050	.....	.....	17
4, 065	223, 963	282, 339	490, 000	949, 678	.....	.....	146, 286	2, 080, 625	.....	.....	18
3, 441	289, 885	390, 200	1, 171, 900	1, 689, 357	.....	.....	1, 114, 158	1, 577, 050	.....	.....	19
2, 714	123, 175	225, 436	118, 950	785, 287	408	.....	.....	60, 000	.....	.....	20
487	29, 830	253, 795	151, 775	518, 420	.....	.....	.....	.....	.....	.....	21
1, 300	246, 600	245, 750	639, 000	2, 776, 724	.....	4, 300	.....	.....	.....	.....	22
156	13, 272	40, 538	55, 500	132, 550	.....	.....	.....	187, 500	.....	.....	23
784	61, 245	138, 733	204, 850	302, 242	.....	.....	221, 748	350, 925	.....	.....	24
501	9, 790	25, 985	15, 500	192, 482	.....	.....	.....	20, 000	.....	.....	25
167	15, 000	4, 400	23, 000	81, 000	.....	.....	.....	47, 300	.....	.....	26
6, 618	292, 720	560, 763	489, 636	602, 239	.....	.....	303, 829	2, 218, 376	.....	.....	27
334	6, 610	8, 648	4, 000	109, 960	.....	61, 412	.....	10, 000	.....	.....	28
319	24, 975	145, 165	26, 000	253, 100	.....	.....	.....	.....	.....	.....	29

An additional amount of completed manuscript of considerable magnitude has been delivered during the year to the Superintendent of the Census, for publication in the Census Report upon the statistics of the fisheries and fish trade of the United States, consisting of Parts V and VI of this report, as indicated in the analysis printed above.

15.—SUPPOSED DESTRUCTION OF THE TILEFISH.

Reference has been made in a preceding report to the phenomena connected with a wholesale destruction of the tilefish (*Lopholatilus chamæleonticeps*), an important food-fish recently brought to notice by the U. S. Fish Commission as occuring off the coast. The futile efforts to find even a few survivors were recorded in the report for 1882. A new attempt was made in 1883 by the Albatross, which proceeded to the ground and devoted several days to using a well-baited trawl and hand-line. She failed to meet with success, however, and for the present, at least, we must give up any expectation of renewing our acquaintance with the species. The search developed the remarkable fact that the associates of the tilefish, which were formerly found in great abundance at the same place, have either disappeared entirely or are represented by only an insignificant remnant. There is no theory that accounts for these phenomena satisfactorily, although it is suggested that it may have been due to an incursion of cold water from the arctic region or of warm water from the Gulf Stream. It is not unreasonable to presume that either of these conditions would produce an effect on fishes living in an intermediate temperature.

16.—THE POLE-FLOUNDER.

The pole-flounder, which was one of the most important discoveries made by the Commission in the earlier years of its work, continues to be met with over a wide range, occurring in a greater and greater depth as one proceeds southward. It is taken in almost every haul of the dredge, down to several hundreds of fathoms. As an article of food it is at least equal, if not superior, to any species of that family in the United States. The anomaly of its being so abundant, and yet never being taken except by the U. S. Fish Commission, is explained by the fact that it can be caught only by means of the trawl-net, the mouth of the fish being so small and weak as to prevent its swallowing a hook large enough to sustain its weight when hauled up. Connoisseurs in New York, to whom specimens were sent, pronounced it to be one of the best of American fishes, and in every respect equal to the far-famed sole.

17.—THE BLACK COD OF THE PACIFIC.

Among the fisheries of the United States of much promise in the future, but not yet developed, is that of the black cod (*Anoplopoma fimbria*), a species not in any way related to the true cod. It occurs along

the entire coast of California, Oregon, and Washington Territory, its extreme northern range not being determined. It is not much esteemed in its southern area of distribution, but in Washington Territory it is very highly prized, being much sought by the Indians. It lives in deep water, and can be caught on trawl-lines like the cod and halibut. We owe to Mr. James G. Swan, of Port Townsend, Wash., the first suggestion of the commercial and economical value of this fish for food purposes, and he informs us that the fish is eaten both fresh and salted. Several hundredweights of the salted fish were sent to the Commission by Mr. Swan, and these were treated, at the suggestion of Mr. Wilcox, by smoking, after which they were distributed to experts, who pronounced the fish to be one of the best known to them. Especial interest was excited among the fish dealers of Gloucester, Boston, and New York, and several expressed the intention of sending some one to Washington Territory for the purpose of effecting large catches of the fish for regular market treatment.

18.—NEW MODEL OF FISHING VESSEL.

As stated elsewhere, Captain Collins, a member of the Commission, is at present engaged in preparing the model of a fishing schooner to combine the best points of the American and British vessels, and made after studying the peculiar characters of both. It is proposed to ask from Congress the means to build after this model, and should it be generally followed, we may hope to witness a notable decrease in the loss of life and property. In 1883 Gloucester had a fleet approximating 400 fishing vessels, carrying from 4,300 to 4,800 men. About one-half to three-fourths of this fleet has been engaged in some branch of the winter fisheries, the rest of the vessels being hauled up about five months in the year.

In the ten years from 1874 to 1883 the total loss of vessels was 147, of which number 82 foundered at sea, 7 of the latter having been abandoned in a sinking condition. The total value of these vessels was $735,126. The total loss of life was 1,233 men, 895 of whom went down in their vessels, which foundered at sea. It is a little difficult to get at the exact number of bereaved families that lost their natural protectors, since for one or two years of the period under consideration accurate record was not kept of the widows and fatherless children left by these disasters at sea, and even if it had been it would not show how many almost helpless parents were deprived of their only means of support. As near as a correct estimate can be obtained, and this is probably an underestimate, 322 women were made widows and 658 children left fatherless by the disasters to the Gloucester fleet alone. Many of these families were left in utter destitution.

There can be but little doubt that upwards of 75 per cent of the vessels lost at sea meet with an untimely fate simply because they are too shallow; the consequence being that when caught in a gale they are

liable to be thrown on their beam ends, and, not being able to right because of their shallowness, fill and sink. In a single gale, that of December 9 and 10, 1876, no less than five Gloucester schooners were knocked down and barely escaped sinking. Three of them were dismasted, two of which were abandoned; one went into Liverpool, Nova Scotia, under a jury-rig; while the others were not so badly damaged. The inference is that other vessels that foundered in the same gale, and those that have been lost at sea on other occasions, were knocked down in a similar manner, and, failing to right again, soon sunk. Of course, with a deeper body to the vessels, and the ballast placed lower, there would be far less probability of such a mishap occurring, and even should it happen the chances would be a hundred to one that the vessel would right again. It is, therefore, altogether probable that the introduction of deeper fishing vessels in New England would save for Gloucester alone somewhere about $30,000 to $50,000 per year, besides a large number of lives.

As an instance showing how terrible the loss is sometimes, from the 29th of August to the last of December, 1883, 16 vessels from Gloucester foundered at sea, carrying down with them 205 men, while the loss of property was little less than $100,000.*

19.—FISHERIES OF THE GULF OF MEXICO.

One of the subjects to which it is proposed to direct the work of the steamer Albatross hereafter is the investigation of the fisheries of the Gulf of Mexico. These, which a few years ago were very prolific, are rapidly diminishing in number, so that all along the coast between the mouth of the Mississippi and Pensacola a much larger number of boats and vessels are required to secure only half the supply that was obtained a few years since. The reduction applies mainly to sheepshead, salt-water trout, redfish, mullet, gray-snapper, &c. The decrease of the red-snapper is not quite so marked, but it is probable that it will in time take place even more rapidly than the others, as it is particularly

* Mr. R. B. Forbes, on the same subject, says: "I have perused with great interest the statements on the subject of the loss of life among the fishermen of Gloucester. The loss of 447 vessels and 2,600 lives in fifty-four years ending in 1884 is fearful to contemplate. In twenty-two years ending this year the number of men lost was 2,140. There must be some cause for this large increase. It may be presumed that the increase of the number of vessels in the business accounts for the increased loss of lives in a great degree. Another cause must be the fact that the vessels are more crowded. Another prominent cause must be the fact that trawl-fishing in dories necessarily exposes the men to greater danger than hand-fishing. I have before me a long list of men who have been separated from their vessels; many of these have been lost, while some have been rescued in a starving condition. No regular rule has been established for furnishing dories with condensed food and means for cooking. This should be done. Mr. D. W. Low, of Gloucester, has contrived means not only to feed persons, but to enable them to right their dories and to cling to them when capsized. If the owners of fishing craft do not feel interest enough to encourage the use of these means, there should be a law to compel them to do so."

sought after by fishermen. The cause of the decrease is probably partly overfishing in particular localities, and partly the numerous pestilences and mortalities by which so many are exterminated. No satisfactory theory has been presented for this mortality, although an intelligent writer suggests that it is due to the influx of the cold water found near the sea bottom at great depth even in the Gulf Stream, which has the same effect as the northers on the coast of Texas during the winter-time.

20.—TREATY OF WASHINGTON.

The termination of that part of the treaty of Washington relating to the fisheries is attracting much attention on the part of fishermen; and the question is being mooted as to how this is likely to affect American interests, and what should be done by the United States in the way of renewal. A proper investigation of the subject can be had only after a careful study of the influence the twelve-year period has had upon the welfare of the American fishermen and the amount of the catch. The U. S. Fish Commission has for some time been engaged in securing the data necessary to consider the subject fairly and thoroughly, should it be brought before a commission such as sat at Halifax in 1877.

21.—COD GILL-NETS.

The importance of the introduction, by the U. S. Fish Commission, of the method of catching codfish by the use of gill-nets, has never been so apparent as during the winter of 1882–'83. Owing to the almost total failure of the bait supply it was impracticable to carry on the shore cod-fishery by the old method of hook-and-line fishing. Such a scarcity of bait was never known before, and if the fishermen had not been instructed in the use of gill-nets for the capture of cod a valuable and important industry must have been almost abandoned for the season, at least while the scarcity of fresh cod in our markets would have increased the price to such an extent as practically to place this important article of food beyond the reach of the masses.

But during the previous two years the New England fishermen learned a great deal about catching codfish in nets from an illustrated pamphlet containing descriptions of all the methods, which was freely circulated by the Commission, and to this was also added the knowledge gained in a practical way. They were therefore prepared to meet the emergency, as, instead of being compelled to give up the shore cod-fishery, they met with a success which has rarely or never been equaled. Such excellent results obtained by the use of gill-nets in the cod fisheries that the local papers in the principal fishing ports contained frequent notices of successful catches. The Cape Ann Advertiser of December 8, 1882, gives the following account of the "Good results of net cod-fishing."

"On Tuesday, December 4, boat Equal, with two men, took 5,000 pounds of large codfish in seven nets off shore, sharing $40 each. The

Rising Star has stocked $1,200 the past fortnight fishing in Ipswich Bay. The Morrill Boy has shared $101 to a man net-fishing off this shore the past three weeks."

The last mentioned schooner, the Morrill Boy, met with unexampled success, her crew of five men having shared $320 apiece, clear of all expenses, by the last of December, the time employed being less than six weeks.

From the port of Gloucester alone, according to Capt. S. J. Martin, there were employed in the gill-net cod-fishery during December twenty vessels, carrying one hundred and twenty-four men and one hundred and seventy-six nets. In the period between November 19 and the last of December, 600,000 pounds of large shore codfish were landed in Gloucester, while 150,000 pounds were marketed at Rockport and Portsmouth, making a total of 750,000 pounds. When to this is added the amount which was probably taken by the vessels from Swampscott, Portsmouth, and other ports, it is perhaps safe to say that no less than 2,000,000 pounds of this highly valued and most excellent food-fish were taken by nets during the month of December and the latter part of November. The fish caught in nets were of extraordinary size, averaging more than 20 pounds each, while some individuals weighed as much as 60 or 75 pounds.*

During the previous two winters cod were taken in nets, with rare exceptions, only in Ipswich Bay, but this season they were caught very extensively on the rocky shoals in Massachusetts Bay. Since the beginning of January, however, the fish were most abundant in Ipswich Bay, and the fleet of shore cod-fishermen resorted to that locality, where they met with the most encouraging success, the catch during the first month of the year being, it is said, much larger than at any previous time.† The Cape Ann Advertiser of January 26, 1883, contains the following item in relation to this subject:

"The net cod-fishermen are meeting with good success in Ipswich Bay. On Thursday of last week three fares of handsome large codfish, nearly 30,000 pounds, were landed at Portsmouth."

An important matter for consideration in this connection is that not only can the cod fishery be successfully carried on even when bait is

* The above statements are based on the report of the Gloucester fisheries for November and December, by Capt. Stephen J. Martin, of the U. S. Fish Commission, pp. 159–161 of F. C. Bulletin, 1883.

† According to Captain Martin's report for January, 1883, 121,000 pounds of cod that were caught in gill-nets were landed in Gloucester during the month. Under date of February 6, 1883, he makes the statement that ten sail of small vessels, which had been fishing in Ipswich Bay, had landed at Rockport, Mass., and Portsmouth, N. H., during the previous twenty days, 230,000 pounds of large codfish. Calculating on this basis, the total catch of the whole fleet during the month of January would be very large. Owing to the fact, however, that no accurate and reliable statistics of the entire catch in gill-nets, along the whole coast, is obtainable, estimates must be based on the reports of the Gloucester fisheries, which have been carefully made by Captain Martin.

not obtainable—for, of course no bait is required when nets are used—but a very great saving is made in time and expense. As an instance of this it may be stated that the average bait-bill of a shore trawler would be not less than $150 to $250 per month when herring are so high-priced as they were this winter. Therefore it is safe to estimate that, when such a large fleet is employed in gill-netting as there was this season, the amount saved to the fishermen (which otherwise must be paid for bait) cannot be less than $30,000 to $40,000.

The day is now not far distant when the U. S. Fish Commission will be able to supplement what it has done, by propagating the cod on a very extensive scale, this having been found perfectly practicable.

C.—THE INCREASE OF FOOD-FISHES.

22.—BY PROTECTIVE MEASURES.

The question of the proper measure of protection to be given to fish, with a view of preventing their destruction or of securing their increase, is one that has occupied much attention during the past few years. The uncertainty as to whether the United States or the States themselves should enact the necessary legislation has in many cases prevented definite action.

Reference has already been made to the investigations of the Senate committee on fisheries in regard to the amount of protection to be given to the menhaden and bluefish, and the report of this body when issued will doubtless contain much that will be of great importance in the ultimate solution of the problem.

The subject of protection in the Great Lakes is also one that has been recently mooted by various legislatures and conventions, the question being somewhat complicated by the fact that a foreign nation for the most part owns the opposite shores, and that the question of the jurisdiction of the United States as against that of the States separately being, as already mentioned, still unsettled. There are thus three parties in the field, all of whom have to be considered in the inquiry.

Numerous complaints have reached the Commission in regard to the wasteful methods of capture, which seriously interfere with the proper maturing of the many young fish introduced into the lakes by the several States and the United States. These fish, only half grown, are said to be taken by the ton. The remedy suggested is to prohibit the use of any net of a mesh less than $4\frac{3}{4}$ or $4\frac{7}{8}$ inches. It is also suggested that the depth of water in which fishing should be carried on during the spawning season should be regulated.

The lake trout is also a sufferer by wasteful methods of capture; and it is sometimes taken in such quantities as to supply much more than the demand.

A meeting of fish commissioners of States bordering on the Great

Lakes was held at Detroit, October 17 and 18, 1883, to confer upon a better protection of the lake fisheries, uniform laws, artificial propagation, relation of the State commissions to the United States Commission, and the fishery authorities of Canada.

The United States Commission was represented by Mr. Frank N. Clark, who reported an interesting meeting. The following resolution was passed and transmitted to the U. S. Fish Commission:

"*Resolved*, That this conference recommend and respectfully request the fish commissions of the different States bordering on the Great Lakes to urge upon their several senators and congressmen the advisability of securing some action by the United States Government, through the instrumentality of the U. S. Fish Commission, to induce the Commission to send one of its steamers with a sufficient force of scientific men to the Great Lakes, for the purpose of investigating the habits of the fish natural to those waters, the method of fishing pursued therein, and all other matters connected with the fishing industries."

23.—BY THE USE OF FISHWAYS.

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

After careful consideration of the different varieties of construction offered, a plan of fishway suggested by Colonel McDonald has been adopted, and he has been instructed to have prepared the necessary working drawings for the purpose, to be submitted to contractors for estimates. Should this be within the appropriation, it will be recommended to the Secretary of War for such further action as he may think proper.

The early history of this fishway will be found in the report for 1882.

24.—BY THE DISTRIBUTION OF FISH AND EGGS.

As already explained in a previous part of the report, the method of distribution of fish and eggs has been almost entirely changed 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. The work has been mainly under the direction of Colonel McDonald, to whose report in the appendix reference should be made for details. It may be stated, however, that the total number of applications for fish during the year was 10,060. These were mostly for carp. The actual distributions were, in brief, as follows:

Carp.—The total number of carp distributed during the year was 162,000 to 7,015 applicants. These were situated in every State and Territory, 292 congressional districts and 1,308 counties being repre-

sented. The distribution was made during the months of November and December, as being those in which fish can be transported with less danger of injury.

Shad.—The number of shad sent to a distance during the year amounted to 12,408,000, together with about half that number of herring.

Whitefish.—The distribution of the whitefish obtained from eggs taken in 1883, was made for the most part from February to May of the following year; one of the cars being constantly employed during that period in transporting them from the hatchery at Northville, to a suitable point on the lakes. About 49,000,000 fish were thus transferred. The most prominent places of deposit in the Great Lakes were Manistee, Grand Haven, Traverse City, Port Huron, Ludington, Fort Gratiot, and Escanaba, in Michigan; Racine, Milwaukee, Sheboygan, and Ashland, in Wisconsin; North Bass Island, Put-in-Bay Island, and Ottawa City, in Ohio; and Erie in Pennsylvania; while a large number were planted in some interior waters of different States, either directly or through the State fish commissioners.

Of other members of the salmon family an extensive distribution was also made, the details of which will be found in the several special reports. The eggs of these were obtained from Grand Lake Stream and Bucksport in Maine, the trout ponds on the McCloud River, California, and at Northville, Mich., and Wytheville, Va.

25.—SPECIES OF FISH CULTIVATED AND DISTRIBUTED IN 1883.

a. The codfish (*Gadus morrhua*).
b. The Spanish mackerel (*Scomberomorus maculatus*).
c. The rockfish or striped bass (*Roccus lineatus*).
d. The mullets (*Mugil*).
e. The whitefish (*Coregonus clupeiformis*).
f. The brook trout (*Salvelinus fontinalis*).
g. The lake trout (*Salvelinus namaycush*).
h. The saibling (*Salmo salvelinus*).
i. The California, rainbow, or mountain trout (*Salmo irideus*).
j. The Atlantic or Penobscot salmon (*Salmo salar*).
k. The Schoodic or landlocked salmon (*Salmo salar* subsp. *sebago*).
l. The European trout (*Salmo fario*).
m. The quinnat or California salmon (*Oncorhynchus chouicha*).
n. The shad (*Clupea sapidissima*).
o. The carp (*Cyprinus carpio*).
p. The goldfish (*Carassius auratus*).
q. The golden ide or orf (*Leuciscus idus*).
r. The tench (*Tinca vulgaris*).
s. The catfish (*Amiurus*).
t. The clams.
u. The American lobster (*Homarus americanus*).
v. The oyster (*Ostrea virginica*).

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

The Fulton Market (*New York City*) *Station.*—As referred to in previous reports, a renewed effort was made to utilize the live spawning codfish brought in during the winter season to Fulton Market, the necessary facilities in the way of a station being furnished by Mr. E. G. Blackford, fish commissioner of New York. The work was begun on January 8, and by the 11th 4,000,000 sound eggs were obtained. A reasonable number of these were hatched out and deposited, but further operations for the winter were prevented in consequence of the destruction of the adult fish by slush ice in the East River. Mr. S. I. Kimball, Superintendent of the Life-Saving Service, on application of the Commission, kindly ordered the crew of the life-saving stations on Long Island to assist in collecting eggs of cod should they be procurable.

On a previous page reference has been made to the continued life history of the school of cod hatched out at Gloucester in 1878–'79. It is not improbable that the fish first hatched out have reproduced their kind, as young gray cod of two sizes are now taken during the summer on the coast. In 1882 they were abundant off Portsmouth, N. H., the fishermen being satisfied that they were the result of the work of the Commission. During the summer of 1883 numbers were taken in the mouth of Gloucester Harbor, one man capturing 70 or 80 pounds on a mackerel line, the fish weighing from half a pound to 2½ pounds each. It would seem from these statements that not only have these fish been successfully planted, but also that they have changed their habits and are likely to continue to be an inshore summer fish, which is of course a desideratum of very great importance. A note given below from Mr. R. S. Tarr, an intelligent naturalist and resident of Gloucester, contains further information on this subject.*

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* While in Gloucester recently I made some inquiries in regard to the report that small cod of the species *Gadus morrhua* were very abundant in the harbor. Although I was there in the wrong season, still I think that I gained enough information to establish beyond a doubt that small cod, some as large as 14 inches in length, belonging to *G. morrhua*, are extremely abundant at Gloucester; and as these belong to the species which is at present almost entirely deep-sea, it seems evident that we must look to some other causes than natural ones to explain the appearance of such great numbers in so small an area, for as far as I can find out only one other school has been seen along the New England coast in shallow water. I talked with several fishermen, and they all reported the abundance of the "silver-gray cod," which could not be distinguished by them from the deep-sea cod. The most intelligent and observing of all with whom I spoke was Mr. Edwin F. Parsons, of East Gloucester, who expressed a willingness to correspond with you upon the subject, and also to make preparations of specimens, under your direction, if you desired it.

He told me that in the spring and summer for the two past seasons, while fishing for bait for his lobster traps, he took great numbers just outside of Ten-Pound Island. Their abundance dwindled down until in February they were least abundant. Last spring the largest fish weighed 4 or 5 pounds, and often in a day 100 pounds would be the result of his catch. He did not fish especially for these, but simply for bait for his traps. The cod he would sell, while the other fish would serve his purpose. He thinks that he can see three generations, the largest weighing 5 pounds and the

b **The Spanish Mackerel** (*Scomberomorus maculatus*).

The Fish Hawk Station.—An effort was made during the present summer to hatch eggs of the Spanish mackerel in the Chesapeake Bay on board the steamer Fish Hawk, under the command of Lieut. W. M. Wood. The vessel was occupied in the work from June 21 to August 13, the first ripe spawn being obtained at Mobjack Bay on the first-mentioned date. During the month of July the fishermen were very successful with their nets in taking fish, but it was found difficult to obtain ripe eggs among them. In all, 6,500,000 eggs were taken in June and July and placed in the cones for hatching. The result was, however, in every instance a loss of the eggs, except on July 4th, 250,000 hatched and were returned to the water. Lieutenant Wood, in his report in the appendix, has given an account of the efforts made, and, together with Dr. Kite, has described the apparatus made use of for hatching.

c. **The Rockfish or Striped Bass** (*Roccus lineatus*).

In view of the rapid decrease in the abundance and size of striped

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others considerably smaller. Although he has been fishing for seven or eight years, never before 1882 did he find deep-sea cod in any numbers inside of Gloucester Harbor. Taking into account this fact, Mr. Parsons feels confident that they can be no other than the fish put into the harbor in 1879; and he wished me to say that he feels thankful for the money he had made and the chowders he has had, as he expressed it, at the expense of the Fish Commission. Considerable enthusiasm is expressed among the fishermen in regard to this matter, and they feel anxious that the work started in 1878 shall be continued. Not only are these fish caught in the outer harbor, but even in the innermost docks of the inner harbor, boys, while fishing for flounders, frequently land gray cod. This is extremely remarkable—that such cod should be found in the very impure water of the docks. But still this is asserted by many. My cousin, Mr. Spinney, who for many years was a practical fisherman and a good observer, and now the head of a firm which handles thousands of cod every month, has examined them critically and compared them with deep-sea cod, and said positively that they were the same. The specimen sent by Mr. Wonson is *G. morrhua*. If you wish specimens in alcohol, Mr. Spinney will obtain any that you want upon receiving directions from you. Mr. Spinney sees nearly all the cod which enter Gloucester, and upon being asked if the gray cod was found at other points along the coast he said that the only instance that he knew of was the case of a vessel which had just landed 15 barrels of cod taken in shallow water near Mount Desert. I went to the wharf and found the fish, which proved to be *morrhua*, 14 inches long. I obtained two specimens for the National Museum. They seemed to run about the same size, varying about 1 inch in length, and correspond in size almost exactly with the specimens taken at Gloucester. These may be a portion of the cod from Gloucester emigrating from their original home. As this was the only case which I could find of the *G. morrhua* being found in shallow water, outside of Gloucester, I am inclined to the opinion that they are but an offshoot of the Gloucester cod.

Another recognized good caused by the Fish Commission while at Gloucester is in regard to the reddening of fish. I was informed by several fish-dealers who have adopted your suggestion to use Trepani salt instead of Cadiz, that not a single instance of reddening has occurred during the past summer. The butts used for pickling the fish exhibited a tendency to turn red only when they had previously been saturated with Cadiz salt.

WASHINGTON, D. C., *November* 12, 1883.

bass on the coast the Fish Commission has been desirous of increasing the supply by artificial propagation, but the difficulty of finding the ripe parent fish has hitherto been a barrier in the way. At the request of the Commission Mr. S. G. Worth, superintendent of fisheries of North Carolina, made some experiments at Weldon, in that State, and found that it was practicable to secure quite a number of the breeding fish. He hatched out many of them successfully, and obtained data enough to warrant the hope that the work might be done on a much larger and more efficient scale hereafter.

In June, 1882, as previously recorded, with a view of determining whether the rockfish or striped bass could be kept in pens until their eggs should ripen, a large number were placed in the pool at Battery Station, near Havre de Grace. No fish larger than 8 pounds were secured, so no results were obtained. Some of them, however, lived into the summer of 1883, but as they were not adult, and no effort was made to feed them they were found to be in poor condition.

It may be remembered that several years ago the fish commissioners of California secured the services of Mr. Livingston Stone to transport a number of young striped bass to California waters. Since then report has been made of captures of these fish, one of them on November 7, at San Francisco, weighing 17 pounds.

d. **The Mullets** (*Mugil*).

Several species of this genus occur very abundantly on the southern coast, so much so, indeed, as to constitute a special fishery; but nothing has been done in regard to introducing them to other waters. They are found in small numbers eastward, Vineyard Sound being perhaps the limit of their occurrence in that direction. Here, however, they are small and of no commercial value. Some species thrive in fresh water. The experiment has been made by the California fish commissioners of transporting a Sandwich Island species into that State, although I have no report as to the general result. This fish is propagated in the harbor of Honolulu, being reared in artificial ponds made in the salt marsh lands near that city, and large quantities are obtained there for the market. They are much esteemed as an article of food, and the subject is one that will be deserving of future consideration.

e. **The Whitefish** (*Coregonus clupeiformis*).

The Northville Station.—The anticipations excited by the great success of this station in previous years were fully met during 1883, under the continued supervision of Mr. Frank N. Clark. Perhaps the most important improvement this year in the arrangements for hatching consisted in the introduction of the McDonald jars, which proved an entire success and suited to the enlarged operations of the station. The water supply was thought not to be sufficient for increasing the old method of service, but the economy of these jars, which permitted the water to be used over and over, rendered the fears groundless. The

first instalment of whitefish eggs was received November 14 from Lake Erie, and the last was received December 1. A heavy storm in the middle of November made it necessary to abandon Lake Erie, and the bulk of the eggs was obtained from Lake Huron, the principal places being at the mouth of Thunder Bay. Some very heavy catches of whitefish were made on the Canada side around Duck Island, one propeller having on board 45 tons of whitefish at a single time. These whitefish were large, specimens weighing from 15 to 20 pounds being frequently taken, and the largest weighing 26 pounds. The experiment of holding adult whitefish in inclosures until the eggs were ripe was renewed, and proved as successful as it had been during the previous years. The fish were kept in floating crates at North Bass Island, in Lake Erie, and at Alcona, in Lake Huron. The crates were anchored about 20 rods from the beach, in 12 feet of water. From the fish confined therein 5,000,000 eggs were taken, and not a fish died while confined in the crates.

During the season 25,000,000 eggs were brought from the fisheries direct to Northville. There were transferred from the Alpena Station 35,000,000 eggs, making a total of 60,000,000 handled at this station. Of this number 12,000,000 were sent away and 8,000,000 were lost in various ways, the total number hatched at this station being 40,000,000. Of the 12,000,000 eggs which were removed 1,000,000 were sent to Germany, 1,000,000 to New Zealand, and the remainder to State and national hatcheries. Those sent to foreign countries reached their destinations in good condition; those for New Zealand having been received at San Francisco and forwarded by Mr. R. G. Creighton, and those for Germany having been repacked and forwarded from New York by Mr. Fred Mather.

The young whitefish began to hatch out on the 16th of February. On the 20th, car No. 2, in charge of Mr. Ellis, was loaded with 3,000,000 eggs to be taken to Manistee. The car made trips back and forth from the Great Lakes until all were disposed of.

Quite extensive operations were prosecuted at this station in brook trout, lake trout, rainbow trout, and German trout, which will be treated under their proper heads.

The Alpena Station.—This station was supplied with both the McDonald and Chase jars, and the water supply obtained from the city waterworks. Not being, however, upon a railroad it was necessary to transfer 35,000,000 of eggs to the Northville hatchery in order to avoid moving live fish. The supply of eggs which was derived from 68 pound-nets and numerous gill-nets, filled 375 jars. Of these 32,000,000 were hatched at Alpena, and the remainder sent to Northville. The fry hatched at Alpena were planted mostly on the west coast of Lake Huron in April, 1884.

The question has arisen as to whether it is better to deposit the young fry of whitefish and other salmonidæ in distant waters, as soon as the

yelk bag is absorbed, or to keep them until they have attained considerable size, and can better protect themselves against their enemies. When, however, fish are cultivated on the scale adopted by the Fish Commission, it is almost impossible to find the necessary inclosures where they would have sufficient room, or to supply the food that they would consume. For if 100 fish would devour an ounce of food each day, 1,000,000 would consume about 600 pounds, or 108,000 pounds in six months. The estimate in this case is probably much below the actual figures.

Another point is as to the length of time it should take to hatch out the eggs, whether it would be better to use warm water from springs to accelerate this result or to retard it by applying the colder water of the lakes. This question has not yet been satisfactorily decided, the action of the fish commissioners of the States varying in this respect.

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

The Northville Station.—During the season between October 10 and November 21, there were taken from the creeks near the hatchery 200 brook trout, of which 33 were found to be ripe females, and which yielded 18,000 eggs.

There were in the station some 10,000 fry, 2,000 yearlings, 500 two-year-old trout, and 500 three and four-year-olds. From these fish a large number of eggs were taken. Of these, 25,000 were sent to Germany, 150,000 to Washington, and smaller numbers to various State hatcheries. The eggs taken from the wild trout were hatched, and the fry returned to the streams.

Ten thousand trout eggs from the 1882 stock were forwarded, January 13, to E. G. Blackford for transmission to Bogota, U. S. of Colombia.

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

The Northville station.—A large number of lake trout were captured in Lake Erie, the best days being early in November. The fish spawned this season much later than usual. Although no eggs were taken after November 18, a good many fish were reported as yet unripe. There were 280,000 eggs taken, of which 25,000 were sent to Germany and 100,000 to Washington. There were also 105,000 eggs at Northville, and the young distributed by car No. 2 to Strawberry Lake, Star Lake, and Crooked Lake, in Northern Michigan. The remainder were deposited in Arnold's Lake, in Washtenaw County.

The lake trout promises to be an important inhabitant of cool lakes, and even of flowing streams. The young exchanged with fish-culturists in France and Germany have succeeded very well, and give great satisfaction. Numerous letters are on file in the office of the Commission making grateful acknowledgment of the favor.

h. **The Saibling** (*Salmo salvelinus*).

Among the most highly esteemed species of the trout family of Europe is the saibling, known in England as char and in France as *ombre*

chevalier. Through the courtesy of the president of the *Deutsche Fischerei-Verein* a number of the eggs were received in January, 1881, and sent to the fish commissioners of New Hampshire, at Plymouth, for development. They proved hardy and grew satisfactorily, and on December 3 of the present year about 600 eggs were taken by Commissioner Hodge. These will be transferred to another station, to be hatched and reared; and it is hoped that the species may in time become well known in this country. The fish is specially adapted to the deep waters of cold lakes, being very abundant in the Geneva and other lakes of Switzerland.

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

The McCloud River Station.—The season for taking trout eggs opened on January 3 and continued until the 5th of April, when it was found that from over 33 spawning females 388,000 eggs had been taken. Mr. Loren W. Green was more particularly in charge of this station, although Mr. Stone retained the general supervision, and the latter states that Mr. Green is entitled to great credit for the endurance and perseverance exhibited in his work.

Each year a number of parent trout are taken from the river for the purpose of replenishing the trout ponds and to make up for the yearly losses sustained. This season, for the first time, several thousand young trout were reserved in the hatching troughs, and, later, 12,000 were placed in a pond by themselves to be reared for breeders. This necessitated some new ponds, which were built during the year. In order to help maintain the supply 20,000 fry were turned loose in the river. Of eggs there were lost during the various operations but 24,000, and the remainder, 332,000, were forwarded to Washington and various State hatcheries. For further details of the work reference may be made to the report of Mr. Stone in the appendix, where will be found some interesting remarks upon the abundance of panthers, wild-cats, lynxes, raccoons, minks, otters, and other frequenters of the region.

The Northville Station.—It has been found that since the rainbow trout were brought from California to this station their habits have so far changed that they have become winter spawners. Mr. Clark believes that in a few years they will spawn simultaneously with the brook trout. In January and February he took 125,000 eggs, but only succeeded in fertilizing one-fourth of them. He shipped 12,000 eggs to Mr. Mather for Germany, 3,000 for France, and 3,000 for England. He hatched 10,000 fry, which were planted in Indiana, Michigan, and Ohio. There was also received a case of 4,000 rainbow-trout eggs on March 18 from the McCloud River station. These arrived in prime condition, and the fry which were hatched from them were added to the breeding stock. Two new trout ponds were completed in June of the present year.

The introduction of the California trout to Eastern waters was first

made in a practical manner by the New York fish commission, its well-known superintendent, Mr. Seth Green, having brought a number from the McCloud River to the State hatchery at Caledonia, from which to obtain eggs for distribution in various waters in the State of New York. Subsequently the U. S. Fish Commission established the ponds on the McCloud River, of which such frequent mention has been made in previous reports. The rapid growth and game qualities of this fish, and its adaptation to many waters where the brook trout will not thrive, have caused the great demand which it is not easy to supply, but which the Fish Commission is now endeavoring to meet as far as possible. Reports from various quarters on this fish are very satisfactory. By planting them in public waters they are likely to extend over a wide area, and furnish to all an opportunity for capturing them. A specimen caught in the free water of the Roanoke River of Virginia weighed about 10 ounces. It was the product of an egg hatched about two years before.

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

The Bucksport Station.—Mr. Charles G. Atkins continues in charge of this station, and, as heretofore, the operations were conducted jointly by the United States and the Maine and Massachusetts Fish Commissions. As heretofore, the breeding salmon were purchased from the Penobscot River fishermen. There were secured 431, which averaged 18 pounds in weight, this being about 5 pounds heavier than the average of the previous year. It was found, however, that the large salmon were much more susceptible to injury from handling than smaller ones, so that of the 431 purchased but 267 reached the breeding ponds. There was an unusual proportion of female fish, and, as already indicated, they were of extraordinary size. Consequently the spawning operations which lasted from October 29 to November 7 resulted in the taking of 2,535,000 eggs, an average of 12,000 to the fish. Prior to shipment between 4 and 5 per cent were found defective, leaving 2,420,000 sound eggs. A pro rata division of these gave to the United States 1,370,000, to Maine 700,000, and to Massachusetts 750,000. From the United States quota 500,000 eggs were sent to the Cold Spring Harbor Hatchery, which were incubated with very slight loss, and were planted in several New York streams. Of the 100,000 sent to Wytheville, 50,000 were hatched and planted in the Oswego River, and the remainder were retained at the hatchery. From the Maine quota large deposits were made in the Androscoggin River, Crooked River, Webb's River, Sandy River, Piscataway River, Mattawamkeag River, and the Denny's River. Thirty thousand were sent to Northville.

The Northville Station.—On February 28, a case of 30,000 Penobscot salmon eggs was received from Bucksport, Me., which on being unpacked, were found in good condition. The fish hatched out between March 16 and March 24. the loss being but about 600. Over 29,000

were planted on May 25 in the headwaters on the Huron River, in Oakland County, Michigan.

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

The Grand Lake Stream Station.—This station, which continues in charge of Mr. Charles G. Atkins, was eminently successful during 1883. During the fishing season which existed from October 29 to November 20 there were taken only 1,005 fish, of which 709 were females and 296 males. As with the salmon, however, they proved to be large and prolific. From the 661 females found to be ripe 1,070,500 eggs were secured, an average of 1,623 to each female. The heaviest female weighed 8.8 pounds, and the heaviest male 5.4 pounds. The new hatchery, which was erected in 1882, proved very useful, and the eggs taken were divided between the two hatcheries, the one fed by spring water and the other by lake water. After the removal of the unfertilized and other imperfect eggs, there remained 960,000 for use. Of these 240,000 were set aside as a reserve, 373,000 assigned to the United States, 133,500 to Maine,133,500 to Massachusetts, and 80,000 to New Hampshire, this being in proportion to the funds contributed by each.

From the United States quota, 5,000 eggs were sent to New York, and forwarded by Mr. Fred Mather, by the steamer Baltic, to Sir James G. Maitland, Stirling, Scotland. The remainder of the United States lot was assigned to State commissioners, some thirteen different States sharing in the distribution. In general, these eggs reached their destination in good order, and were successfully hatched and deposited in suitable waters, the full details of which will be found in a table appended to Mr. Atkins's report.

It has so far proved almost impossible to meet the call for eggs or young of this fish.

l. **The European Trout** (*Salmo fario*).

Eggs of this species were received from Mr. Von Behr, the president of the *Deutsche Fischerei-Verein*, in the winter of 1882–'83, and were sent directly from New York to the station at Northville, where they arrived on February 18. The eggs were successfully hatched out by Mr. Clark by the middle of March, and early in April were planted by him in a branch of the Pere Marquette River of Northern Michigan.

The European trout is an excellent table fish, and attains a much larger growth than the species found in the United States, a weight of from 10 to 20 pounds being not unusual. It is hoped that it may be available for some localities not so well fitted for the brook trout, where, by its rapid growth and the size to which it attains, it may constitute an important article of food.

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

The McCloud River Station.—An unprecedented and unforeseen condition of things was experienced at this station during the present

year. The hatchery was put in order at the usual time, and an annex 80 feet long by 8 feet wide was built for the purpose of accommodating an additional 2,000,000 salmon eggs for the California commission. When the time came for salmon to arrive, few if any were to be found. Mr. Livingston Stone, who is still in charge of this station, arrived at the station August 1, and on the 7th of August, when it was expected that 500 or 1,000 salmon would be taken, but one specimen, and that a small one, was caught. As the days passed on the numbers continued very small; and it was not possible to secure during the latter time more than 1,000,000 eggs, and a careful investigation was made of the cause of the scarcity. It was found that from 3,000 to 6,000 Chinamen were at work on the California and Oregon Railroad, which runs along the Sacramento River, 8 or 10 miles below the hatchery. The blasting operations of the railroad company were on a gigantic scale, it being stated on good authority that two six-horse wagon loads of gunpowder were used at a single blast, and that this blasting was kept up day and night. Mr. Stone considers this blasting to be an ample explanation of the failure of the salmon to ascend the river. But it was also alleged, with some show of truth, that the Chinamen did a very large business in capturing fish below, while they were at work, by exploding giant powder in the river. As before stated, but 1,000,000 eggs could be obtained. These were handled with great care, but on the 19th of September an accident happened to the wheel, which cut off the supply of water, and 25 per cent of the eggs were lost before the necessary changes could be made. The remainder were turned over to the California fish commission on the 6th of October, to be hatched and returned to California waters.

In addition to the scarcity of salmon in the McCloud, which was attributed to the operations on the railroad, it was discovered that there were very few salmon in the Spokane River. This was the cause of considerable consternation to the Indians who annually encamped near Spokane Falls in anticipation of a large run. Up to October 1, they had obtained not more than a few dozen fish, while in 1882, a traveler reported seeing from 40,000 to 50,000 salmon drying at one time under the care of the Indians.

The catch of salmon at the canneries on the Sacramento River was fully up to that of the previous year. The total for the year ending October 15, 1883, was stated to be 451,957 spring salmon and 160,542 fall salmon, weighing 7,349,988 pounds, delivered to the different fishing firms. The wholesale dealers received 115,004 spring salmon and 52,902 fall salmon, making a grand total of 780,405 salmon, weighing 9,585,672 pounds.

The average yield of the canneries on the Sacramento for the years 1881, 1882, and 1883 was 9,596,984 pounds. The average yield for 1875 and 1876, before any fruits of fish-culture could have appeared, was 5,205,102 pounds, a net gain per annum of 4,391,882 pounds.

A small consignment of salmon eggs, for experimental purposes, was forwarded from California to Washington by express, arriving October 4. The long time they had been on the way, with perhaps insufficient care in transit, caused the loss of the entire lot from overheating.

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

With a view of ascertaining what could be done in the southern waters in the way of hatching shad, Mr. Ferguson started on board the steamer Lookout, and arrived at the mouth of the Saint Mary's March 20, from which point he proceeded to the Saint Mary's River and made a careful examination of it as far as Clark's Bluff, a distance of 30 miles. At this point the nets of Mr. Pierson were being fished with a result on the average of 100 shad per day, several ripe ones being found among them. Having ascertained that good hatching work could be done on this river, the Lookout next proceeded to the Saint John's River, which was reached on the 22d of March. On the way to Jacksonville many gill-nets set for shad were observed, but there was a complaint of the scarcity of fish. Yellow Bluff, a small settlement below Jacksonville, was found to be the center of the shad fishing on the Saint John's River. At Jacksonville the shad in the market appeared to be about a week or ten days from maturity. From Jacksonville the steamer proceeded to Palatka and Lake Monroe, where small shad-fisheries were found. Returning on the 27th, the vessel left Jacksonville on the 28th, and after a stop at Saint Augustine arrived in Washington April 19. For successful work on the Saint Mary's it was decided that everything should be in readiness for operations by the 1st of March.

During this season the following stations have been occupied for the purpose of hatching shad and herring on the Potomac and Susquehanna: (1) Quantico and Glymont by the Fish Hawk; (2) Fort Washington for collecting the eggs; (3) Central Station for hatching eggs brought from the river; (4) Battery Station, Havre de Grace.

Quantico Station.—Having taken on board the usual shad-hatching outfit the Fish Hawk, under Lieutenant Wood, left the navy-yard, April 12, for the mouth of Quantico Creek, for the purpose of establishing a station for hatching eggs of shad, herring, perch, &c. On the next day Lieutenant Wood visited the fisheries within reach, and found that Budd's Ferry was not being fished at all; that Stump Neck fishery would begin shortly; that the Freestone Point fishery was in full operation and doing well, 400 and 600 shad having been caught in two hauls that day, as well as 10,000 herring. The fish, however, were found to be unripe, and the temperature of the water 60°. There were taken, however, that day 50,000 eggs from a herring. On the 24th of April Lieutenant Wood reported, that owing to a protracted rain, the temperature had fallen to 50, and had completely arrested the development of the eggs in the cones. Young herring, estimated at 600,000 in number, were put in the river that day (the change of temperature killed about

7,000,000 others). The water continued cold, and very little being accomplished, the vessel was moved higher up the river, to Glymont, May 7, where it was continuously engaged until the 28th of May, when it returned to the navy-yard. On the 8th of May Lieutenant Wood reported having taken 12,000,000 eggs of herring, 60,000 of perch, and 7,000 of shad.

Fort Washington Station.—This station was placed in charge of Lieut. William C. Babcock, U. S. Navy, and the Secretary of War having given the desired permission to occupy the grounds and buildings, the work began April 14. Some difficulty was found in inducing the fishermen to co-operate. Mr. L. G. Harron was permitted to fish the Fort Washington shore on condition of supplying eggs to the Commission. The fishing shores of Moxley's and Brant's Points, Ferry Landing, and White House were visited regularly during the season, which on the whole was a bad one, being interrupted by rains and change of temperature of the water. Lieutenant Babcock, however, was able to obtain 21,850,000 eggs. The first eggs, 64,000 in number, were taken April 14. The greatest number of any one day (1,140,000) were taken May 19. On the 21st of May Mr. Harron violated his contract and withdrew his seine, when it became necessary for the Commission to put its own net into the water and to haul it during the remainder of the season. This was done very successfully, and a larger average of shad were taken in it than had been taken in Mr. Harron's seine. The last eggs taken during the season were 15,000, June 10, when seining was discontinued; and on the 13th all of the eggs were transferred to Central Station, as during the early portion of the season the river steamers were depended upon for transportation. After the 8th of May the Lookout was at the disposition of Lieutenant Babcock, and enabled him to turn the eggs over much more promptly to be hatched. Lieutenant Babcock was assisted by Mr. John Lucket, in charge of the seine, and by Mr. James Carswell, who had immediate charge of the spawn-takers. His report will be found in the appendix.

Central Station.—This station was used for hatching the eggs sent up from Fort Washington. The young fish when ready for shipment were transferred directly from the hatching apparatus to the cars. This was great saving of time and of risk and expense of removal by wagons.

Battery Island Station.—The arrangement of the grounds, buildings, and other improvements made at this island for the purpose of utilizing the extensive fisheries in the vicinity, were quite fully described in the report for 1882.

The management of this station for 1883 was placed in charge of Lieut. W. F. Low, U. S. N., who was furnished with a seine 906 fathoms in length, to be operated by steam, and a force of 30 men. On the 19th of April the first shad eggs, 25,000, were secured, and other were obtained on the following day. From the 22d to the 27th of April it was impossible to accomplish anything; after that, however,

eggs were obtained daily, during the remainder of the season. The shad caught, if not ripe enough for spawning purposes, were placed in a large pool or reservoir until they became so, and were then caught and stripped. On the 12th of May, Mr. Frank N. Clark, of Northville, visited this station for the purpose of observing particularly the effects upon the shad of their being penned during this stage. His report will be found in the appendix. His experiments appended show that the female shad is extremely sensitive to the least interference with its method of reproduction; and that under certain circumstances injuries will result. Some of the shad with roe particularly affected as the result of confinement in the pool were sent to Mr. John A. Ryder, at Washington, the biologist of the Commission. He discovered certain abnormal appearances with a peculiar tendency toward fluidity. He decided that impregnating such ova would be out of the question.

On the 4th of June, Lieutenant Low was relieved from duty at this station, and Mr. Frank N. Clark placed in charge thereof. Lieutenant Low had collected 6,363,500 eggs, had deposited in local waters 3,751,500 fish, and delivered to be distributed by the Fish Commission messengers 1,633,000 fish.

From June 4th to June 8th Mr. Clark collected 1,096,000 eggs, from which there were hatched 768,500 fish, of which 521,500 fish were planted in the bay, and the rest delivered to the Fish Commission messengers.*

A pamphlet of three pages, entitled "Inducements offered fishermen to furnish shad eggs for the U. S. Commission of Fish and Fisheries," prepared by Lieutenant Babcock, was issued to shad fishermen during the season. In this, full instructions were given for stripping shad and caring for the eggs. It was also stated that the necessary apparatus would be furnished upon application to the Armory building in Washington and on board the steamers, and that a liberal price would be paid to the gillers, pound-net, and seine fishermen for eggs taken according to the instructions and delivered on board the steamers of the Commission as they made their daily trips. The instructions were also published in the Bulletin of the Fish Commission, vol. ii, page 389.

This season the experiment of shipping shad eggs by express on trays covered with wet cloths was first tried by Colonel McDonald. A lot of eggs thus sent to S. G. Worth, Raleigh, N. C., reached their destination in excellent condition.

*The shad fisheries of Havre de Grace in 1883 were reported to have given occupation to 259 men, 6 engines, and 15 horses, using 4,217 fathoms of seine. The number of shad taken was 46,967. These were sold mostly in Philadelphia, the Baltimore market being supplied by day fishermen. In addition to the shad which were seined, 16,500 were caught in gill-nets, making a total for Havre de Grace of 62,967 shad. The statistics of all the fisheries of the Susquehanna and at the mouth of the Chesapeake, could they have been obtained, would probably have shown a total catch of 100,000 shad for the season.

o. **The Carp** (*Cyprinus carpio*).

The work connected with the carp may be considered among the most important of the operations of the Commission. The good results have been manifested over the entire country and the demand for the species is increasing year by year. The history of the fish is given in ample detail up to date in previous reports, and it is sufficient here to recall the fact that they are all produced in the city of Washington, for the most part in the ponds at the foot of the Washington Monument, though a portion are raised in the ponds near the Washington Arsenal, the occupation of which has been sanctioned by the War Department. The scale carp are cultivated exclusively at the Arsenal ponds, while the mirror and leather varieties are reared in the Monument ponds.

The area of the Arsenal ponds is about one-fourth of an acre; that of the Monument ponds is given in the accompanying foot-note.*

The increasing demand for carp has made it necessary to extend the facilities for raising them, and an arrangement was entered into for making some new ponds along the line of Virginia avenue, which it is hoped will be ready in time for service in 1884.

The attention of the Commission has been attracted for some time to a new race of carp known as the blue carp, which was supposed to be

*ELEVATIONS.—Curves of elevation above mean high water are shown for differences of 1 foot; the heights are given in feet.

BENCH-MARK.—The top of the brick wall at the southeast corner of the south wall of the north gate chamber of west pond is 2.875 feet above mean high water of the Potomac River, and was established by the city engineers.

AREAS.

		Acres.
East pond		6.437
West pond (water surface, 6.642 acres; two islands, 0.403 acre)		7.045
North pond	4.346	
South pond	1.500	
Pond No. 1	.078	
Pond No. 2	.086	
Pond No. 5	.157	
Pond No. 6	.178	
Remainder of island, including turtle pond, tanks, ponds Nos. 3 and 4	.576	
Total of north and south ponds combined, including the island between		6.921
Ground between east pond and B street		2.301
Ground between east pond and Executive avenue		.882
Ground between north pond and B street		.229
Ground between north pond and Seventeenth street		.349
Ground between north pond and Executive avenue		.280
Ground between west pond and Executive avenue		2.354
Ground between west pond and Potomac River		.219
Ground between west pond and Seventeenth street		.160
Seventeenth street from B street to Potomac River		2.989
Virginia avenue, as inclosed		2.438
Grand total		30.604

preferable in some respects to the other varieties. Through the courtesy of the *Deutsche Fischerei-Verein*, a number of specimens were received and placed in the ponds. They will be isolated from the other varieties, and their young will be distributed to such persons as wish to have them.

Much trouble is experienced at the United States carp ponds from the attacks of birds, rats, and snakes, the attention of the superintendent and his assistants being constantly occupied in destroying them. During the year more than a thousand water-snakes were destroyed, mostly by shooting them. Many fish-hawks, kingfishers, night-herons, &c., were also killed.

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

Central Station.—Goldfish were raised as usual, in large numbers, at the carp ponds under the direction of Mr. Hessel.

During this year there were 5,001 goldfish distributed to 802 applicants, in thirty-three States and Territories.

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

This ornamental fish, which occurs in great variety and is very attractive, is cultivated by the Commission for distribution. It attains a length of about 18 inches, is of a beautiful orange red when seen from above, and silvery when observed laterally. It is continually in motion and swims round in schools close to the surface of the water, being in this respect much preferable to the goldfish. It has proved to be a very delicate fish, and though quite a number have been raised and distributed, serious losses are experienced by the cold snaps which kill the eggs.

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

A small number of tench are cultivated in the Washington ponds, but there is little demand for them.

s. **The Catfish** (*Amiurus*).

In previous reports reference has been made to the successful introduction of the catfish (*Amiurus nebulosus*) into the waters of California, their multiplication, and the very high esteem in which the fish has been held as an article of food. Specimens have been taken from that State to Nevada by Mr. Parker, fish commissioner of the latter State, where it bids fair to multiply. There are quite a number of species from which a selection may be made, and there is every reason to believe that the fish will in time be in great demand among fish-culturists.

Mr. J. F. Jones, of Hogansville, Ga., has been cultivating one of the Southern species and considers it a very important food-fish, growing very rapidly, living on vegetable substances, and spawning when one year old. A fuller statement of Mr. Jones's experience with this fish will be found on page 321 of vol. iv of the Fish Commission Bulletin.

t. **The Clams.**

The occurrence on the Pacific coast of the United States of several species of edible clams of very great value has induced the Commission to inquire into the propriety and importance of transplanting them to the waters of the Atlantic, and Mr. R. E. C. Stearns, an eminent conchologist, was requested to visit the localities and make a report upon the subject. As the result of his inquiry he finds that several species are worthy of consideration, especially one of them which normally weighs 4 pounds and occasionally as much as 18. As soon as practicable, the necessary effort will be made for their transplantation. Little if anything, however, can be done until there is railway service to the localities in Washington Territory where the clams can be most readily obtained. A report made by Mr. Stearns on the subject of these clams, with illustrations of the several species, will be found in the Fish Commission Bulletin for 1883.

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

The highly-prized American lobster, which occurs from Labrabor to Delaware Bay, although most abundant in New England, and formerly so plentiful, is now becoming scarce, and much apprehension is felt as to the danger of extinction within a comparatively short period. The diminution in question is not only in number but in size, it being, of course, quite natural that the larger ones should be more closely pursued. A principal cause of this decrease has been the enormous consumption by canning factories, where many millions of pounds are annually put up for exportation to all parts of the world. It is perhaps quite safe to say that within twenty years the decrease all along the coast has amounted from 50 to 75 per cent.

The question of the artificial production of the lobster is one that is beset by many difficulties, especially in view of the fact that the eggs are fertilized within the body of the female, and subsequently attached by a small, short pedicel to the hairs of her legs, where they are kept in constant motion. Artificial impregnation is therefore out of the question, and in what way the eggs can be best developed, whether in connection with the parent or removed and reared in hatching jars, is yet to be settled. Experiments are, however, in progress in this connection, and the results will be published hereafter.

The bulletins of the Fish Commission contain numerous articles on this subject, and in the forthcoming quarto series an elaborate paper by Mr. Rathbun will be found upon the past and present distribution, statistics, &c., of this animal. Something may be done in the way of multiplication of the species by transplantation, and an experiment has lately been tried by the Commissioner in this direction. On August 24 of the present year one hundred live lobsters, partly with eggs, were obtained through the assistance of Mr. E. G. Blackford, of New York, and transported on the Fish Hawk from Fort Pond Bay, Long

Island, to the ripraps in Chesapeake Bay, with the loss of only two or three individuals. It is hoped that future reports may contain a further history of this experiment.

v. The Oyster (*Ostrea virginica*).

Experiments with the eggs and embryos of the common oyster (*Ostrea virginica*) were carried on for the season of 1882 at the experimental station on Saint Jerome Creek, Maryland, by Col. M. McDonald and J. A. Ryder, under the auspices of the U. S. Fish Commission. Other experiments were also conducted at Beaufort, N. C., by Francis Winslow, U. S. N., and Prof. W. K. Brooks, while Mr. Henry J. Rice made investigations in Mr. E. G. Blackford's laboratory, Fulton Market, New York City. Mr. Rice has since then published his results in Forest and Stream and in the thirteenth biennial report of the commissioners of fisheries of the State of New York. His laboratory experiments made upon a limited scale involved the use of two vessels; one as a supply reservoir for the water used in the incubation of the eggs, and another vessel used as a receptacle in which the young oysters were successfully confined. Bands of flannel were used as capillary conductors of the water from the supply reservoir to the hatching-box, and a similar band was used to carry the water from the latter into an outside reservoir. By means of such an apparatus the experimenter was enabled to keep the young oysters, placed in the vessel, alive for fourteen days. Certain improvements in this apparatus made afterwards have rendered it more perfectly adapted to the purpose for which it is designed, that is, the outlet pipe has been so arranged as to prevent the escape of the whole of the water from the hatching-box, and in such a way as to make the method available in the construction of large ponds for the artificial rearing of the oyster.

Mr. Ryder left Washington with the U. S. Fish Commission steamer Fish Hawk in June, 1882, but did not begin any actual experiment until July 3 following. In the course of his investigations in 1882, in cooperation with Colonel McDonald, it was found to be possible to carry young oysters, which had been reared from artificially fertilized eggs to the condition of fixation, twenty-four hours after fertilization, as he has already reported in a paper entitled "An account of experiments in oyster culture and observations relating thereto (second series)," and published in the report of the U. S. Commission of Fish and Fisheries for 1882. These experiments led to the attempts made in 1883, which have resulted in the demonstration of the fact that oyster spat can be reared from artificially impregnated eggs, as was shown experimentally at Stockton, Md., during last season on the premises of Messrs. Shepard and Pierce, these gentlemen generously bearing the expense of the construction of the pond in which the experiments were conducted under the supervision of Mr. Ryder.

The results of the Stockton experiments have been fully described in

an article by Mr. Ryder published in the Bulletin of the U. S. Fish Commission, vol. iii, 1883, pp. 281–294, and it has there been shown that in a pond 3½ feet deep and covering an area of about 50 square yards, connected by a trench 10 feet long with Chincoteague Bay, it was possible to secure spat from artificially fertilized eggs, provided that the fertilized brood introduced into the inclosure was confined by means of a porous diaphragm of sand fixed into the trench, through which the tide could ebb and flow, so as at once to confine such brood and also exclude injurious enemies from entering the pond from the open waters.

Forty-six days after the beginning of this experiment oyster spat from one-fourth to three-fourths of an inch in diameter was found affixed to the shell collectors hung upon stakes in this inclosure. These results have led to the establishment of small breeding ponds at the oyster-cultural station of the U. S. Fish Commission at Saint Jerome Creek, Maryland, where further experiments in artificial breeding will be conducted during the season of 1884, the condition there being now such as to give every indication of the fact that we may reasonably expect to meet with the same success as was had at Stockton last year.

The set of spat during the season of 1883, as elsewhere mentioned, was unusually large, the season being apparently an exceptionally favorable one.

The work of the oyster commission of Maryland in revising the statutes regulating the oyster fishery of that State has also been an important step in testing the effects of restrictive legislation, and we may watch with no small degree of interest the results of the action of the Maryland oyster commission, the views of which have been enacted into statutes by the State legislature.

It may and very probably will be found possible to extend the northern system of deep-water oyster culture to the whole of the deep-water Chesapeake area, in the event of which the States of Virginia and Maryland should take joint action in framing a law or laws the object of which should be to protect and encourage those engaged in the industry. Systematic culture in the Chesapeake Bay can be made to produce great results, and place that region pre-eminently above all others combined as respects the annual yield of oysters.

The year 1883 has also been an unusually noteworthy one in respect to the number of persons who have, as specialists or experts, contributed to our knowledge and life history of the oyster. In the front rank among these must be mentioned Prof. Thomas H. Huxley, who gave an address before the Royal Institution of London, May 11, 1883, which was afterwards published in the English Illustrated Magazine, for October and November, 1883, in which he gives a remarkably clear and readable account of the life history of the European oyster (*Ostrea edulis*), and with characteristic clear-sightedness gives expression to his views as to what is to be done about the oyster question.

The Dutch zoological commission has also been active, and prob-

ably the most noteworthy contribution to the literature of the anatomy of *O. edulis* which has appeared in Europe for thirty years past is a paper entitled "De Voortplantingsorganen van de Oester, Bijdrage tot de kennis van hun bouw en functie," by Dr. P. P. C. Hoek, and illustrated by six well-executed lithographic plates. This paper, published in the Journal de la Société Néderlandaise de Zoologie (Liv. I, 1883), gives for the first time a fully illustrated description in Dutch and French of the organs of Bojanus of *O. edulis*.

The same paper also contains the most complete bibliography extant of works relating to the oyster and oyster culture, which may be consulted by those interested, with the assurance that about all that has been written upon the subject up to within the last two or three years has been noticed.

Professor Horst, of the Dutch commission, has also made some important investigations upon the early stages of development of *Ostrea edulis*, in which he has indicated the true nature of the gastrula stage of this mollusk and the mode in which the supraesophagal ganglion is developed.

During the same period the French naturalists have also been very active, notably G. Bouchon-Brandley and Adrien Certes. The former of these was the first to introduce a successful method of rearing the spat of the diœcious *O. angulata* from artificially impregnated eggs at Verdon, in inclosed ponds, in 1882, though constant daily tidal action was not permitted to effect the change of the water in the ponds as in the American experiments with the eggs of *O. virginica* instituted by Mr. Ryder.

American investigators have been no less active than their foreign brethren. Prof. W. K. Brooks and Lieutenant Winslow—the first as the biological editor of the report of the oyster commission of the State of Maryland, and the latter in his elaborate investigations upon the distribution, area, and condition of the oyster beds of the Eastern United States—have contributed much valuable information upon the subject of the oyster industry of America.

Dr. W. M. Hudson and Hon. Robert G. Pike also deserve particular mention here in connection with their effective efforts in improving the condition of the oyster beds under the jurisdiction of the State of Connecticut.

Mr. J. A. Ryder, of the U. S. Fish Commission, has also been active in contributing towards a knowledge of the life-history of the American oyster. His experiments and investigations have covered a large range of work upon the anatomy, histology, and physiology of the animal. Among the most important of his researches are as follows: Those which have determined the true nature of the "greening of oysters," the absorption of phycocyanin from the diatoms swallowed as food, and its retention by the colorless blood corpuscles of the animal; the structure of the gills, circulatory system, and reproductive and excre-

tory organs; the discovery that the reproductive organs might be almost or altogether atrophied at the end of the spawning season; the elucidation of the effects of osmose and its influence in affecting the bulk and appearance of the flesh of the oyster so as to improve or injure its appearance for the markets, when immersed for a short time in less dense or denser water than that from which the animal was first taken; the true nature of the so-called fattening process, the kinds and distribution of the food of the oyster as well as its messmates and parasites.

Besides the minor papers which Mr. Ryder has issued during the past year upon the subject of oysters and oyster culture he has had prepared under his direction "A Sketch of the Life-History of the Oyster" for the annual report of the geological survey of the Territories for 1883, besides a paper entitled "A Contribution to the Life-History of the Oyster" for the forthcoming quarto fishery report of the U. S. Census. In both of these papers the author has very fully illustrated the anatomy and development of the American oyster with carefully drawn figures.

D.—ABSTRACT OF THE ARTICLES IN THE APPENDIX.

26.—CLASSIFICATION OF ARTICLES.

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

A.—General.

The first paper is by Lieut.-Commander Z. L. Tanner, and gives a full account of the construction and outfit of the steamer Albatross, illustrated by a number of figures and more than fifty plates. It is followed by his report on the work done by the steamer during the year 1883. In this he has included the subordinate reports of Capt. Jacob Almy, Ensign R. H. Miner, Passed Asst. Surg. C. G. Herndon, Lieut. Seaton Schroeder, and various tables of temperatures, specific gravities, speed of trawlings and soundings, stations occupied, &c. A paper by Livingston Stone is entitled "Explorations on the Columbia River, from the head of Clarke's Fork to the Pacific Ocean, made in the summer of 1883, with reference to the selection of a suitable place for establishing a salmon-breeding station." This is followed by a reprint of the British sea-fisheries act of 1883.

B.—The Fisheries.

In this section are found ten papers, the first giving a tabulated estimate of the catch of fish of the principal rivers of the United States in 1880. This was prepared by Mr. Smiley from material collected during the work on the Tenth Census, and shows a total of 184,783,050 pounds.

The same author presents the statistics of the United States imports and exports of fishery products for the current year. These are based upon information furnished by the Bureau of Statistics. A paper on the fisheries of Great Britain and the Fisheries Exhibition of 1883, by R. W. Duff, M. P., is presented in abstract as somewhat explanatory of the great International Fisheries Exhibition. Of the two papers relating to the whale fisheries, the first is a statistical review of the past two years, compiled by Mr. Smiley, and the second a translation from the German of a description of Svend Foyn's whaling establishment. A translation from the Swedish of Prof. A. V. Ljungman upon the great herring-fisheries is of interest. It is followed by two papers from the Danish upon the Norwegian fisheries of 1883, and the Iceland cod-fisheries of 1883. A paper upon the fisheries of India by Francis Day, formerly inspector-general of fisheries in India, gives a very comprehensive view of that industry. The last paper is by Rudolph Lundberg, upon the Swedish eel-fisheries and the apparatus used therein.

C.—Economic Research.

Prof. W. O. Atwater has presented herein his second contribution to our knowledge of the chemical composition and nutritive values of American food-fishes and invertebrates, a former paper on the same subject having been furnished by him for the Report of 1880.

D.—Natural History and Biological Research.

Of the six papers in this section the first two relate to the explorations made by the Commission along the Gulf Stream, Professor Verrill presenting the general results of the Albatross explorations in 1883, and Miss Bush giving a list of the deep-water mollusca dredged by the Fish Hawk in 1880, 1881, and 1882. In a paper by A. V. Ljungman, translated from the Swedish, will be found some valuable notes upon the natural history of the herring and the management of the herring fisheries during the past ten years. A paper by R. W. Shufeldt, M. D., upon the osteology of *Amia calva* is illustrated by fourteen plates; and one by Gustav Eisen, entitled "Oligochætological Researches," is illustrated by ten plates. The last paper is by William P. Seal, upon the aqua-vivaria as an aid to biological research, and is illustrated by three plates.

E.—Propagation of Food-Fishes.

The sixteen papers in this section relate mostly to the propagating operations of the Fish Commission, and consist of reports from the persons charged with the work of propagation or distribution. These are upon the fish eggs sent to foreign countries, by Mr. Mather; the operations at Northville and Alpena Stations, by Mr. Clark; the salmon- and trout-breeding work on the McCloud River, by Mr. Stone; the Penobscot and Schoodic salmon work in Maine, by Mr. Atkins; the

miscellaneous work at the Central Station, by Mr. McDonald; the shad-hatching operations at Fort Washington, by Lieutenant Babcock; the shad-hatching at Havre de Grace, by Lieutenant Lowe; the experiments in penning shad, by Mr. Clark; the general work of distribution, by Mr. McDonald; and the hatching of Spanish mackerel, by Lieutenant Wood and by Dr. Kite. There are also included three papers upon carp culture, which have been considered worthy of translation from the German, the first by Prof. B. Benecke, the second by Max von dem Borne, and the third by Adolph Gasch.

F.—MISCELLANEOUS.

In this section will be found a short account of the laying out of oyster ponds at Saint Jerome, by Lieutenant Wood; suggestions to keepers of life-saving stations and others, relative to the best means of collecting and preserving specimens of whales and porpoises, by F. W. True; and a compilation of statements concerning the fisheries of several different countries, as reported by the United States consuls abroad to the United States Department of State.

This series of forty papers contains many that are considered of very high value, and is illustrated by more than one hundred and fifty plates. Ten of the longest papers are provided with special indexes, as it is often desirable to issue these in separate pamphlet form for distribution to specialists not interested in the contents of the entire volume.

E.—SUPPLEMENT TO THE REPORT PROPER.

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

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

List of light-houses on the Atlantic coast at which ocean temperatures have been taken during the year 1883, 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.
Alfred J. Leavitt, 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 12
Pollock Rip light station, entrance to Vineyard Sound.
Joseph Allen, jr., South Yarmouth, Mass 12

Nantucket New South Shoal light-station, Davis New South Shoal.
Andrew J. Sandsbury, Nantucket, Mass 12
Cross Rip light-station, Vineyard Sound.
Luther Eldredge, Chatham, Mass 12
Buoy Depot, Government wharf, office inspector second division.
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, 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, Port Jefferson, N. Y 12
Fire Island light-house, south side of Long Island.
Seth R. Hubbard, Bay Shore, N. Y 12
Sandy Hook light-house, entrance to New York Bay.
James Cosgrove, 128 Rutledge street, Brooklyn, N. Y. (succeeded by A. H. Pritchard, 120 Spencer street, Brooklyn, E. D., N. Y., in April) 12
Absecom light-house, Absecom Inlet.
A. G. Wolfe, Atlantic City, N. J 12
Five-Fathom Bank light-station, off Delaware Bay.
William W. Smith, Cape May City, N. J. 12
Fourteen-Foot Bank light-station, Delaware Bay.
Ed. A. Howell, Delaware City, Del. (succeeded by John Lund, Wilmington, Del., in October) 12
Winter-Quarter Shoal light-station, Chincoteague Island.
C. Lindemann, 857 Broadway, Brooklyn, E. D., N. Y 12
York Spit light-house.
James K. Hudgins, Port Haywood, Va 9
Wolf Trap Bar, Chesapeake Bay, Virginia.
John L. Burroughs, New Point, Matthews County, Va. 12
Stingray Point light-house.
C. S. Lankford, Sandy Bottom, Va. (succeeded by Charles F. Sadler, Hudgins, Va., in April) 12
Windmill Point, mouth of Rappahannock River.
James G. Williams, Hookumfair, Va 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.
Deward Rumley, Beaufort, N. C 12
Frying-Pan Shoal light-station, Cape Fear.
John D. Davis, Smithville, N. C 12
Rattlesnake Shoal light-station, off Charleston.
John McCormick, Charleston, S. C 12
Martin's Industry light-station, Port Royal Entrance.
John Masson, Port Royal, S. C 12
Fowey Rocks light-house, Fowey Rocks.
John J. Larner, Miami, Fla 12
Carysfort Reef light-house, Florida Reefs.
F. A. Brost, Key West, Fla 11
Dry Tortugas light-house, Loggerhead Key.
Robert H. Thompson, Key West, Fla 12