REPORT OF THE COMMISSIONER.

A.—GENERAL CONSIDERATIONS.

1.—INTRODUCTORY REMARKS.

In presenting herewith the tenth of the series of annual reports upon the work of the United States Fish Commission, being for the year 1882, I hope to show a continued increase in the extent and efficiency, and, I trust, utility, of its work.

A volume has been published annually, with a single exception, when, for reasons explained at the time, the reports for the years 1873–'74, and 1874–'75, were combined.

The establishment of the Commission in 1871 at the time appeared to be but a slight incident in the history of the country. As previously shown the work first intrusted to the Commission was that of investigating the alleged decrease in the food-fishes of the United States, and it was not until the second year of its existence that action looking towards the propagation of food-fishes, and their transfer to, or multiplication in, the waters of the United States was ordered and authorized.

With the acquisition, by the favor of 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 the Commission itself or by specialists to whom the facilities of the service are extended in the way of use of boats, of stations, and of material.

The Commission has also made very large collections of aquatic animals, especially of fishes, shells, corals, crustaceans, star fishes, &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 labelled 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 which 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 direct to the Commission, they are referred to the member for his indorsement and recommendation.

Some of the most noteworthy features of the year 1882 are as follows:

1. The appropriation made by Congress to supply the full amount necessary for the construction of the new steamer Albatross and the completion of the vessel.

2. The change in command of the steamers of the Fish Commission by the transfer of Lieutenant Tanner from the Fish Hawk to the Albatross, and of Lieutenant Wood from the Lookout to the Fish Hawk.

3. The purchase and employment of a Herreshoff launch, No. 82 of his series.

4. The acquisition of land at Wood's Holl for a permanent sea-coast station.

5. The appropriation made by Congress for the improvement of Wood's Holl harbor by the construction of a pier and breakwater, to be utilized indirectly in the interest of the Fish Commission and its operations.

6. The fitting up of the Armory building as a station both for hatching and for the distribution of fish, and establishing it as the central Washington station; the bringing of a branch track from the Baltimore and Potomac Railroad into the grounds, and their inclosure by a substantial high fence; also the erection of a large storage-shed.

7. The appropriation by Congress for the participation by the United States Fish Commission in the London International Fisheries Exhibition.

8. The proposed action by Congress in regard to the construction of a fishway in connection with the dam at the Great Falls of the Potomac.

9. The acquisition by the Commission of the control of the grounds at Wytheville, Va., belonging to the Virginia State Fish Commission, and the fitting them up specially for the hatching of California trout.

10. The transfer of the control of Saint Jeromes Station from the Maryland Fish Commission to that of the United States.

11. The commencement, on a large scale, of preparations for the artificial propagation of oysters at Saint Jeromes.

12. The practical completion of the work undertaken by the Fish Commission for the census of 1880.

13. The order of Congress to print a large work in three quarto volumes upon the fisheries of the United States.

14. The great expansion in the work of production and distribution of the carp.

15. The practical extermination of the tile-fish in the North Atlantic.

These several points will be more fully discussed in their appropriate places in the report.

A brief memorandum of what the United States 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 been scarcely 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 the publication of the results and the distribution of duplicate specimens to colleges and academies in the United States be carried out on a large scale, so as to meet a large and increasing demand with teachers and students.

2. The 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 cod-fish, 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, 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.

Among the subjects to which the attention of the Fish Commission has been directed is that of the best method of preserving nets in a condition for continued use by preventing them from rotting.

Netting is usually treated by saturating it with some repellant substance, which prevents the moisture from remaining in the interstices of the thread or causes it to dry more rapidly. The usual practice is to soak the nets in a solution of catechu, tannin, or other astringent preparation, or else to apply tar or asphaltum. Salting is also frequently practiced.

A material has lately been offered by Messrs. Horner & Hyde, of Baltimore, which promises good results. Another preservative has also been offered from California, but has not yet been received in sufficient quantity to be tested.

An article by Professor Storer on this subject will be found in the appendix.

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 cod-fish and halibut will be found in their old 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 even more 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 Southeastern 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 only to 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 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. Notably 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 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 herrings (including the shad). At that time a comparatively small quantity supplied the demand for fresh fish, and it was easy to more than meet the demand. 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 rapidly 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 the increase of which in their appropriate places and seasons is to be hoped for, in addition to those now occupying the attention of fishculturists, are the cod, the halibut, the common mackerel, the Spanish mackerel, the striped bass or rock-fish, etc.

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 receiving 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 kind 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 United States 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.

The continued increase in the correspondence of the Commission, referred to in the Report for 1881, has been very strikingly manifested during the year 1882, in which the number of official letters written (exclusive of filled blanks and circulars) amounted to over seven thousand as compared with fifty-six hundred in 1881. Letters received were over eleven thousand, nearly all requiring some attention. A large part of this correspondence is attended to by circulars, but as explained these are not included in the account of letters written during the year.

The new office of the Fish Commission (1443 Massachusetts avenue) has proved to be a very great convenience, allowing a much better classification of work and more ample accommodations for archives, records, drafting tables, etc. The building is fully occupied by the Commission, and in another year an additional story will be needed to meet expected requirements.

It is with great regret that I have to record the death, on the 22d of January, at an advanced age, of Mr. H. E. Rockwell, the secretary of the Commission, who had been connected with the Commission from its beginning, in 1871. At that time he was an employé of the Bureau of Education, but was enabled to give part of his time to the Fish Commission. In the course of the next year, however, his services were entirely engrossed by the Commission, and up to within a day of his death he was, with few exceptions, at his post, and actively engaged in his duties.

During the summer of 1881 he was seized with a slight paralytic attack, from which, however, he fully recovered sufficiently to resume his labor, after a few months interval.

Although not actually in the service of the United States Fish Commission, yet, as having been closely related to it by many years of correspondence and of hearty co-operation, I cannot omit referring to the loss which fish culture has experienced in the death of Mr. B. B. Redding, for many years one of the fish commissioners of California.

Mr. Redding was the pioneer of all the work done in the State in connection with the subject of fish culture; not confining himself to the ordinary routine, but busying himself in gathering in from all quarters whatever he thought might benefit the fishery interests of his State.

To him was due nearly all the important measures in connection with the State service, and notably the transfer of shad to the Sacramento River in 1876; of black bass and other eastern fresh-water fishes, and of striped bass, lobsters, tautog, etc.; the arrangement for keeping up the supply of salmon in the Sacramento River, with the aid of the United States Fish Commission; the preparation of ponds for the cultivation of the gourami, etc.

He personally superintended the transfer to California of the first stock of carp given to his State by the United States Fish Commission in 1879.

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

The stations of the Commission enumerated in the last report were, for the most part, occupied during the past year. It may, however, be well to enumerate them again. Classifying them as before, the list is as follows:

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.

Ever since the establishment of the Fish Commission station at Gloucester in 1878, the Commission has kept an office on Fort Point wharf for the collection of facts and specimens, and for constituting a convenient medium of communication between Captain Martin, the agent of the Commission, and the fishermen generally.

Some question having arisen as to the lease, the quarters in question were given up, and the work has since been performed by Captain Martin without any special headquarters.

2. *Wood's Holl, Mass.*—This continues to be the chief summer locality for investigation and research and 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. It was first established by Maj. T. B. Ferguson, as a commissioner of Maryland, but after a time was operated jointly by the Maryland and United States Commissions. On the 24th of April, 1882, however, it was formally transferred to the United States Commission, and the liabilities of the lease from Mr. John W. Wrightson assumed. All the property of the Maryland commission was purchased at a fair valuation.

B.—PROPAGATION OF SALMONIDÆ.

4. *Grand Lake Stream, Me.*—The propagation of the land-locked 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 is primarily connected with the multiplication of Penobscot salmon, although 1,000,000 eggs of the whitefish sent from Northville, Mich., were hatched here and placed in Eagle Lake, on Mount Desert, at the request of Mr. Montgomery Sears.

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 used also for breeding the Eastern brook-trout and the California trout, of which a good stock is maintained. A supply of carp is also kept here for distribution to convenient localities.

7. *Alpena, Mich.*—This is a new station, established during the present year, 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.

C.—Propagation of Shad.

10. *Havre de Grace, Md.*—The transfer of work from barges anchored in Spesutie Narrows to an artificial island situated near Havre de Grace has vastly increased the facilities for fish propagation, and it is expected that when the station is completely equipped an enormous addition to the number of shad produced will take place.

11. *Washington, Central Station.*—This station, established in the old armory building, was greatly extended in its scope in 1882, and now constitutes the principal point, both for hatching shad and several other fish, and for their distribution by cars to distant parts of the country.

12. *Washington Navy-Yard.*—Work at the navy-yard is prosecuted by permission of the Navy Department and the courtesy of the commandant of the Yard.

13. *Avoca, N. C.*—This station was not maintained during the present year, but was occupied by the North Carolina fish commission with great success.

D.—Propagation of Carp.

14. *Monument Reservation, Washington.*—This is the principal station for the production of carp. The varieties cultivated are the leather and mirror carp. Golden ide and tench are also raised in considerable numbers.

15. *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.—VESSELS OF THE UNITED STATES FISH COMMISSION.

A.—The Steamer Albatross.

In the report for 1881 mention is made of the appropriation of $103,000 by Congress for the construction of a steamer, to be named the Albatross, and to be used by the Fish Commission in investigating questions connected with the fisheries of the high seas. Allusion was also made to the application to the Secretary of the Treasury to take charge of the building of this vessel, and his assignment of the duty to the Light-House Board, which had so ably supervised the building of the Fish Hawk.

As stated, also, in that report, the appropriation made was below the lowest bid, and consequently nothing was done until Congress could be asked for an additional allowance.

This, amounting to $42,000, was made on March 6, 1882, and as the first bids were inoperative competition was again invited, and on August 7, 1882, another appropriation was granted for supplying the vessel with anchors, chain, furniture, apparatus, &c., amounting to $45,000.

Other things being equal the considerations determining these bids were, first, the total amount; and, secondly, the time of completion.

Only three bids were received; as follows: Pusey & Jones, Wilmington, Delaware, $135,000, in six months; Ramsay & Co., Baltimore, $144,000, in twelve months; Malster & Rainey, Baltimore, $145,000, in nine months.

The bid of Pusey & Jones being the lowest, and offering the shortest period for completion, was accepted; especially as their work on the Fish Hawk proved entirely satisfactory to the Commission; and a contract was promptly made, and the work commenced.

On March 15 the Secretary of the Navy assigned Lieut. Z. L. Tanner, commanding the Fish Hawk, to the additional duty of superintending the construction of the Albatross; and on March 29, Passed Assistant Engineer G. W. Baird was ordered to superintend the building of her machinery, receiving a final detail to the vessel on the 31st of March.

Although still in command of the Fish Hawk, Captain Tanner made repeated visits to Wilmington for the purpose of inspecting the progress of the work; until on the 4th of November he was detached from the Fish Hawk, and, on the 10th, ordered to the command of the Albatross, taking charge of the work on the 11th.

Owing to causes beyond their control, Messrs. Pusey & Jones needed an extension of the time of completion of the vessel, which was accordingly granted by the Secretary of the Treasury until the 1st of November, and again extended until December; the delay being caused mainly by the difficulty experienced in getting certain apparatus ordered directly by the Commission as part of the equipment.

The vessel was launched on the 19th of August, and work was prosecuted rapidly, with the interruptions mentioned.

Paymaster G. H. Read, of the Fish Hawk, was ordered to the additional duty of paymaster of the Albatross on November 4.

The vessel was put in commission when Captain Tanner reported for duty, and was supplied with the necessary officers and men by successive detail. The vessel left Wilmington on a trial trip for Washington on December 30, arriving on the 1st of January, 1883. The workings of the machinery were carefully studied, and the vessel taken back to Wilmington for final completion.

The *personnel* of the Albatross, on arrival at Washington, was as follows: Lieut. Z. L. Tanner, commanding; Lieut. Seaton Schroeder; Lieut. S. H. May; Lieut. A. C. Baker; Lieut. C. J. Boush; Ensign R. H. Miner; Paymaster George H. Read; Engineer G. W. Baird; Surgeon J. H. Kidder.

According to the measurements of the collector of customs at Wilmington, Del., by order of the Secretary of the Treasury, the gross tonnage is 625.20; net tonnage, 385.82; displacement, about 1,000 tons.

Her signal letters, as borne on the books of the Treasury Department, are G. V. Q. B.

A full description of the Albatross and of her equipment will appear in a subsequent report.

B.—The Steamer Fish Hawk.

The Fish Hawk continued in active service during the year; partly in connection with the hatching of shad, and partly in deep-sea exploration, with Wood's Holl as a base.

The details of her work will be found under other heads; though it may be mentioned, in general, that after remaining in the navy-yard in Washington during the winter she made an exploring trip in Chesapeake Bay.

The vessel left Washington on February 25, having on board in addition to her usual equipment a large number of gill-nets of various kinds, among which may be mentioned nets for herring, Spanish mackerel, menhaden, shad, whitefish, and cod. One object of the cruise was to set these nets in various parts of the Chesapeake and its tributaries, to ascertain if shad or any other of the anadromous fishes which visit these waters periodically, generally at a somewhat later date, might not be taken in the "deep holes" that occur in certain localities before they made their appearance in the shallow waters off the fishing stations.

The work of research on this occasion was in charge of Capt. J. W. Collins.

Nets were set opposite Point Lookout in 5 fathoms of water, off Barren Island in 20 fathoms, at the mouth of the Patuxent, off Smith's Point and Point Lookout, at Tangier Sound, off Cherrystone, and at the mouth of York River. The results obtained at either of these places were chiefly of a negative character. A few young menhaden were cap-

tured off Barren Island, and a number of dogfish (*Squalus acanthias*) were taken in the nets set off Cherrystone.

Dredgings were made with the beam trawl off Barren Island in 25 fathoms of water, but the captures consisted only of a few young menhaden, some young herring (alewives), and another small fish, besides a single crawfish, a few shrimp, and a limited number of small shells. Another set of dredgings off Cherrystone produced little besides a few specimens of skate (*Raia*, of possibly two varieties). The satisfactory prosecution of these researches were somewhat interfered with by the prevalence of strong winds and tides. It frequently happened that the combined force of the seas and currents drifted the nets from the positions where they were set, and in some instances the apparatus was seriously injured by contact with the bottom, or by drifting afoul of the net anchors as the gear was swept along. It was evident, however, that there were no shad in the localities visited, and, therefore, though the results obtained by the expedition were of a negative character, they were, nevertheless, of considerable value in establishing more definitely than we knew before the date of arrival in the Chesapeake of certain varieties of fishes, while it may, perhaps, be considered settled that no shad, herring, etc., remain inside the capes of Virginia in winter.

Experiments were also made on the cruise to ascertain what might be done in hatching cod-fish eggs in water taken from the Chesapeake. Just before the ship sailed from Washington 1,000,000 cod-fish eggs (about 75 per cent. of which appeared to be alive) were put on board, these eggs being in artificial sea water. Upon arrival at Point Lookout the eggs were put in a glass jar and three cones, and the hatching process begun. That was on Saturday, and the following Monday morning few eggs remained alive, probably not more than one in five hundred, while none had advanced any in development since being placed in water taken from Chesapeake Bay, the density of which was found to be 1.0070, while that of sea water is from 1.0240 to 1.0290. The eggs sunk to the bottom of the hatching apparatus, when put into the water obtained at Point Lookout, and it was not long before examination showed the germinal disk to be much distorted. On Tuesday morning no eggs remained alive, and the embryos that lived the longest were much more misshapen than others which died earlier.

After returning from Chesapeake Bay, the Fish Hawk proceeded to Quantico, Va., on the 10th of April, to carry on the hatching of shad and herring.

On the 7th of July she proceeded to Wilmington with a load of machinery and supplies for the Albatross; and on the 16th of that month was ordered to New Haven to await further orders.

She returned to Washington on the 21st of July, and took on board the usual apparatus and material for Wood's Holl, and left for that station on the 24th, arriving on the 26th.

Several trips were made by her to the Gulf Stream; namely, on the

1st, 10th, and 25th of August, 6th of September, and 3d and 12th of October.

Returning, she arrived in New York on the 20th of October, reaching Washington on the 29th.

On the 20th of November, after the transfer of Lieut. Z. L. Tanner to command the Albatross, Lieut. William M. Wood was transferred from the Lookout to command the Fish Hawk. She was then at the Washington navy-yard, undergoing slight repairs, remaining there until the end of the year.

The *personnel* of the Fish Hawk, at the close of the year, was as follows: Lieut. William M. Wood, commanding; engineer, W. L. Bailie; mate, James A. Smith; mate, C. H. Cleaveland; apothecary, J. Allen Kite, who succeeded Dr. Van Vliet on the resignation of the latter.

C.—The Lookout.

The small yacht steamer Lookout has been constantly occupied during the year in the service of the Commission on the Potomac, on Chesapeake Bay, on the Susquehanna River, and at Wood's Holl.

Up to November she was in command of Lieut. William M. Wood, but when this officer was transferred to the command of the Fish Hawk she was placed in charge of Quartermaster Hamlen.

Her most important operation will be found mentioned under the head of the "propagation of shad," as being engaged in transporting the eggs from the river stations to the hatching houses.

D.—Launch No. 82.

The service of several steam launches is always required in the work of the Commission, especially in connection with the propagation of the shad, for collecting the eggs from distant points, and transferring them to the proper stations.

The Navy Department very kindly furnished the Commission with two launches, as heretofore, namely, Nos. 49 and 55; but an additional one being required, Launch No. 82, subsequently christened the Cygnet, was purchased from the Herreshoff Manufacturing Company, and put immediately into use. This boat, about 33 feet long, was found in every way to answer a satisfactory purpose.

E.—The Canvas Back.

The laying out of the large shad seine at Battery Station, Havre de Grace, requires an extended force of men. For the purpose of economizing the number, plans were prepared for a very light draft steamboat, sufficient to take on board the seine and carry it out over the flats, thus enabling the work to be done in a better manner by a very few persons.

Drawings for a suitable vessel were made under the direction of Maj.

T. B. Ferguson, and estimates obtained from several builders, notably the Herreshoff Manufacturing Company, Pusey & Jones, &c. The cost, however, was much greater than the available funds of the Commission would admit, and the subject was necessarily deferred for a future occasion.

4.—TRANSPORTATION AND HATCHING CARS.

Reference has already been made to the adaptation of a baggage car of the Philadelphia, Wilmington and Baltimore Railroad to the needs of the Commission in the transportation of young fish. For the sake of securing proper attention to this car by railroad companies, it was, by permission, labeled "Pennsylvania," as if belonging to the Pennsylvania Railroad Company.

A second car, authorized by Congress, was built entirely for the Commission by the Baltimore and Ohio Railroad Company, and labeled "Baltimore and Ohio, No. 2, United States Fish Commission."

The entire bill of the railroad company for the construction of this car complete and ready for use amounted to $7,218.55, although some additional expense was incurred in adapting the special fish transporting apparatus, the total cost amounting to about $8,000.

This car was built under the supervision of Mr. F. S. Eastman, and according to a form of trussing patented by him. It offered special advantages in the way of strength and lightness.

The measurement of these cars is as follows: Length of car No. 1, 51 feet 2 inches 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 dimensions of car No. 2 are, length from out to out of buffers, 59 feet 9 inches; total width, 10 feet; height from top of track to top of hood, 14 feet ⅞ inches.

Work upon this car was begun about the 13th of March, and on the 24th of May it was received, completed, from Baltimore. The first trip made by it was with a load of carp, on the 4th of November.

Further details of the uses of these cars will be found under the special heads.

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

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.

THE TREASURY DEPARTMENT.—*The Secretary's office.*—On the occasion of the expected arrival of certain collections of fish from abroad the Secretary of the Treasury directed the collector of customs at New

York to render every facility for their speedy transfer from the vessel to the cars of the Commission.

Light-House Board.—The valued service rendered for so many years by the Light-House Board in authorizing the use of the buoy station at Wood's Holl as a central station of operations has been continued, during the year, and the quarters originally fitted up by the Commission in 1875 were occupied for the third time.

The Board also continued its assistance in forwarding blanks and thermometers furnished by the Commission to various light-ships and light-houses, and in collecting and forwarding returns. The importance of this co-operation on the part of the Board cannot be overestimated, as it enables the Commission to reach a class of intelligent men whose opportunities for observation are of course unrivaled.

The Board has also kept the Commission and its vessels fully supplied with lists of stations and other documents for use in connection with the navigation of the coast.

The Coast Survey.—The Coast Survey has met promptly all demands upon it for maps and charts required for the service of the vessels of the Fish Commission.

THE WAR DEPARTMENT.—*Engineer Bureau.*—The co-operation of the War Department has been exhibited, through the Engineer Bureau, in connection with the work of river and harbor improvements in the vicinity of the stations of the Commission at Havre de Grace, Saint Jerome, and Wood's Holl. A considerable amount of work was done by the Bureau in the improvement of the channel and the approaches to the Havre de Grace and Saint Jerome's stations, adapting them more particularly to the operations of the Commission; the cost being defrayed partly, where this could legitimately be done, from the appropriations for rivers and harbors, and partly from those of the Commission.

The Signal Office.—As heretofore, the Chief Signal Officer has been always ready to co-operate in the scientific work of the Commission, especially in securing records of temperatures of river and sea waters. What he has done in the past will be found fully acknowledged in previous reports, and the records of 1882 show a continuance of his favor. In addition to supplying a full set of meteorological apparatus for the station at Havre de Grace, and less complete series for the steamers of the Commission, he has furnished the greater portion of the thermometers supplied to light-ships and light-houses.

NAVY DEPARTMENT.—The assistance of this Department has from the very beginning been of the utmost moment to the Commission in nearly all branches of its operations. The officers and crew of all the vessels of the Commission are furnished by the Navy Department, including those of the Albatross, the Fish Hawk, the Lookout, and the launches; while all the facilities of the navy-yards, especially that of Washington, have been freely extended.

The *Engineer Bureau* ordered a board to inspect the boiler of the Lookout and to determine the question of repairs necessary to put it in proper commission.

The *Bureau of Construction* placed at the disposition of the Commission two serviceable steam launches (Nos. 49 and 55) for the work of the shad season of 1882.

The *Bureau of Equipment* furnished a number of articles for the equipment of the Albatross.

The *Bureau of Navigation* met all the applications of the Commission for detail of officers in the most cordial spirit, making selections with special reference to the duties to be performed.

The *Bureau of Ordnance* issued a breech-loading gun to the Albatross, and also a number of obsolete powder tanks to be used in making collections of natural history.

THE COMMISSIONER OF PUBLIC BUILDINGS AND GROUNDS.—Col. A. F. Rockwell, the Commissioner, authorized the inclosure of the Armory grounds by a fence, for the better protection of the property of the Commission, and also permitted the construction of a large shed for the storage of packages that could not be conveniently accommodated within the armory.

THE RAILROADS OF THE UNITED STATES.—The various railroads throughout the country have continued to assist in the work of the Commission with the same liberality as before. They have continued their agreement with the Commission to transport fish in the baggage cars of passenger trains without extra charge, allowing the messengers free access to them, as shown by the accompanying list. This privilege has not been of so much importance as in previous years, owing to the much more extended adoption of the system of forwarding the fish either in the transporting cars of the Commission or in those chartered for special trips.

As explained in earlier reports, a special rate has been adopted by most of the roads for this service; this, for the most part, being 20 cents a mile for the transportation of the car on passenger trains, to include the fares of five messengers—any number above this paying the regular passenger fare. This arrangement, first established through the assistance of President Hinckley, of the Philadelphia, Wilmington and Baltimore Railroad, on his own road, and next extended to the Pennsylvania and the Baltimore and Ohio roads, has since become almost universal throughout the country; so much so, indeed, that very little difficulty is experienced in sending the car in any desired direction. In some cases, even, the car is carried without any charge whatever for transportation and messengers, or else at rates below that of 20 cents per mile. In a few cases the charges have been greater than 20 cents; but in nearly every instance there has been an important reduction.

The acknowledgments of the Commission are most especially due for

gratuitous service of the nature mentioned, to the Eastern, Maine Central, and British and North American roads of New England, and the Provinces.

One important consideration in asking from the roads the facilities in question is found in the fact that an appropriation in lump is made by Congress in the interest of the community, and that whatever reduction of cost can be accomplished allows a greater expenditure in some other direction. Twice the amount of the annual appropriation could readily be used; and as the number of streams and ponds to be supplied with fish is of enormous extent, requiring many years, even on the most liberal scale of operation, before they can all be provided for, a selection is, of course, necessary, and is usually made along the routes of greatest co-operation on the part of the transportation companies. There is nothing invidious in such a selection; and as the railroad companies are interested in the prosperity of the regions traversed by them, they feel justified in drawing the action of the Commission in their direction.

I may also mention that the Pennsylvania and the Old Colony Railroad companies prepared special tickets facilitating the transportation of the officers and employés of the Commission to and from Wood's Holl.

While making the acknowledgments of the United States Fish Commission to the railroads for service rendered, what the latter do in the interest of the work of the fish commissioners of the several States should not be overlooked.

In most instances where an active body of State fish commissioners is at work, they can obtain, with little or no difficulty, free passes while on official business, and free transportation for their fish. In a number of the Western States the commissioners devote special attention towards gathering up fish that have been stranded by overflows of the rivers or otherwise dangerously situated, and returning them to the channel; many millions of the most valuable varieties being annually thus saved.

Most of the State work in question has been performed in Virginia, North and South Carolina, Georgia, Illinois, Ohio, Kansas, Iowa, etc.

It would be invidious to mention the railroads, as I am not aware that any application has yet been refused.

FOREIGN STEAMSHIP COMPANIES.—Assistance has also been rendered the Commission during the year by the various steamship companies, particularly the Cunard, the French Transatlantic, and the North German Lloyds, as will be referred to hereafter.

BY OTHER PARTIES.—Mr. Paul Schultz, of Oregon, of the Northwestern Trading Company, offered free transportation to any one who might be sent out by the Commission to study the fisheries of Alaska. I hope to be able to make use of this proposition at an early date.

6.—COURTESIES TO FOREIGN COUNTRIES.

Almost from the very beginning the United States Fish Commission has endeavored to increase the scope of its work by securing any of the varieties of fish from foreign countries that promised to be useful in North America.

Among its efforts in this direction may be mentioned the improved varieties of German carp, the Rhine salmon, the European whitefish and trout, the tench, the ide, the turbot, the sole, and other species. Most of these have been supplied without any charge whatever by foreign governments or fish-cultural institutions, and the United States Fish Commission, desirous of doing its part in the exchange of products, has taken great satisfaction in meeting applications from its correspondents abroad for similar contributions.

In previous reports will be found detailed statements of what has been done in past years in the way of transmitting shad, land-locked salmon, whitefish, California trout, lake trout, black bass, etc., and this international courtesy has been continued during the year 1882 as follows:

France.—On the 14th of January 250,000 eggs of the whitefish and 20,000 eggs of the brook trout were forwarded to the Société d' Acclimatation in Paris, and their arrival in good condition was acknowledged on February 17. On the 4th of March a successful shipment of 10,000 eggs of the land-locked salmon was made to the same country.

Germany.—A large number of eggs of land-locked salmon, lake trout, California trout, and whitefish were forwarded *via* Bremen to the Deutsche Fischerei-Verein, arriving in good condition. Subsequently 10,000 eggs of land-locked salmon were sent to Mr. Ebrecht. On the 29th of April 2,000 eggs of the California trout, (*salmonidæ*) were forwarded to the Deutsche Fischerei-Verein.

Great Britain.—At the request of Mr. George Sheppard Page, thirty-three black bass were sent to the Duke of Sutherland on the 31st of May, of which thirty-one arrived safely. These were placed on April 20 in Loch Brora, a lake six miles long and well suited to the growth of fish.

Chili.—In reply to the application of the Chilian minister in Washington, information was supplied in regard to the more important food-fishes of the United States, and especially the carp. The necessary pamphlets and instructions were furnished for their cultivation, and a promise was made of as many young fish at the proper time as could be conveniently transported.

7.—FISHERY EXHIBITIONS.

It has been my duty to report participation by the United States Fish Commission in two fishery exhibitions—one in Philadelphia, and the other in Berlin. Numerous invitations have been extended to take part

in others—notably those at Norwich, England, in 1881, and Edinburgh, in 1882. As these were occasions of minor importance, the invitations to participate, unaccompanied, as they were, by formal action of the British Government, were not responded to. The exhibitions were held during the years mentioned, and were very successful in exciting interest to the subject of fish culture and the fisheries; so much so, indeed, that it was determined to hold a much larger and more comprehensive exposition in London in 1883. This enterprise soon assumed an international importance, and a formal invitation was extended by the British Government to the United States to take part on this occasion.

The correspondence began by the transmission, on the part of Minister Lowell, of an inquiry from the Earl of Ducie as to whether an invitation to the United States of participation would be received favorably. On the 26th of April the President transmitted to Congress a message on the subject, recommending acceptance of the invitation and an appropriation to carry out its requirements. A bill appropriating $50,000 was reported by the Committee on Foreign Relations of the House, was passed under suspension of the rules, and was concurred in by the Senate on the 13th of July.

On the 3d of May I appeared before the House Committee on Foreign Relations, and on the 26th of May before the Senate committee, explaining the character of the proposed exhibition, and the advantages that the United States might be expected to derive in consequence of her participation.

As soon as the money became available preparations were made for the occasion, and a careful investigation was made as to suitable objects in the National Museum. The deficiencies were then noted, and measures taken to supply them. It was considered particularly desirable to furnish a complete series of models, illustrating the progress of the American fishing vessels from their earliest forms to those of the present day. Preparations were also made for securing all the later and better varieties of tackle and other fishing apparatus of every kind. Small boats, sportsmens' clothing and equipment, samples of the various fishery productions, casts of fishes, fish-hatching—and fish-curing establishments of the country, etc. It was determined also to secure an extensive series of photographs, illustrating everything connected with the fishery industries.

The gentlemen who had been so successful in collecting the statistics for the census department of the fisheries was again assigned to this new service, especially Messrs. J. W. Collins, R. E. Earll, H. C. Chester, A. Howard Clark, and others. Mr. Ellioft, as artist, and Mr. Smillie, as photographer, visited the fishing localities, and made many sketches and pictures and photographs (mostly instantaneous) of much interest. The whole work was under the direction of Mr. G. Brown Goode, assisted, so far as fish culture was concerned, by Major Ferguson, Colonel McDonald, and other specialists of the Commission. Models and maps of the various

fish-hatching establishments of the Commission, with detailed statistics as to their history and management, were prepared. These, however, will be presented more in full in the report for 1883.

It may be stated, in passing, that the time of opening of the exhibition was fixed for the 1st of May, 1883.

By way of experiment as to the possibility of forwarding the well-known painted casts of fish which adorn the National Museum, a box containing a number of them was packed and forwarded to Mr. Wesley, the London agent of the Smithsonian Institution, with instructions to return it unopened. No particular injunctions were given as to the care of the box and its contents; and on its return, some weeks after, the casts were found to be in perfectly good condition, thus giving much encouragement in regard to forwarding a complete series.

Among other special preparations that were made for the occasion, Mr. Lindenkohl, of the Coast Survey, was commissioned to prepare a model of the sea-bottom of the Gulf of Maine, on a scale of $\frac{1}{100000}$. This was intended to exhibit all the principal fishing banks of the region between Eastern New England and Nova Scotia. When completed it was, by permission, exhibited by the Coast Survey, at the Garfield Fair held in Washington in November.

The Commissioner of Patents undertook to bring together a complete series of all the patents which had been issued in connection with fishing and the fisheries during the century. This was done, and the collection filled three stout volumes.

The Superintendent of the Life-Saving Service also took great interest in making a display of apparatus connected with his work.

With the preparations made by the Commission for the London Exposition of 1883, it is hoped that the next report will chronicle as great success on the part of the United States Fish Commission as occurred at Berlin in 1880.

8.—PUBLICATIONS IN 1882.

The most important publication upon which the Fish Commission was engaged in 1882 was the printing of a portion of the Annual Report for 1880, which was, however, not actually completed until 1883.

In the report for 1881 mention is made of the action of Congress in authorizing the printing, annually, of a bulletin of the Commission, to contain notes of discoveries and improvements in fish culture and fisheries, whether made by the Fish Commission itself or by other parties.

The first volume (for 1881) contained a great deal of interesting matter, and was completed in July, 1882, but the second volume for 1882 was more important, as serving as a medium for the immediate publication of interesting facts and suggestions connected with the work of the Commission. It was commenced in August, 1882, and a large portion was printed by the end of the year.

For various reasons it has usually been impossible to get out the full report of the Commission until the second year after date, or even later;

and as the Bulletin is published signature by signature, and distributed in this form, a discovery can be announced within a few weeks after it is made.

About two hundred copies of the Bulletin of 1882 were distributed by signatures to specialists, to State fish commissioners, and to the more important scientific societies, thus giving them the advantage of early knowledge of their contents. The remainder of the edition is distributed by volumes, mostly to the parties receiving the Annual Report.

This work is a public document, and from the large edition printed, Congressmen have copies at their disposal for their correspondents.

A small pamphlet containing the rules and regulations of the Fish Commission for the government of its employés, together with a summary of the Treasury and other Government regulations in regard to the keeping of accounts, was published and distributed to all parties interested in 1882.

Large numbers of circulars required for the current business of the Commission have also been printed and distributed.

Five fishery bulletins prepared by the Commission have been printed by the authorities of the Census Bureau of 1880, and will be found enumerated in another part of this report. These were in continuation of the joint arrangements between the United States Fish Commission and General F. A. Walker, Superintendent of the Census, to which reference is made in another place.

In view of the great delay in getting out the Census publications, authority was asked of Congress to print a special series of reports in quarto that had been contemplated or prepared for the Census, and, accordingly, a joint resolution was passed, as follows:

Resolved by the Senate (the House of Representatives concurring), That the Public Printer be, and is hereby, instructed to print in quarto form a report by the United States Commissioner of Fish and Fisheries upon the food-fishes and the fisheries of the United States, the engraving to be in relief, and to be contracted for by the Public Printer, under the direction of the Joint Committee on Printing, and to receive the approval of the Commissioner before being accepted; the work to be stereotyped, and 10,000 extra copies printed, of which 2,500 shall be for the use of the Senate, 5,000 for the use of the House, and 1,500 for the use of the Commissioner of Fish and Fisheries. There shall also be printed 1,000 extra copies for sale by the Public Printer, under such regulations as the Joint Committee on Printing may prescribe, at a price equal to the additional cost of publication, and 10 per cent. thereon added.

Work was immediately begun on this series, and before the end of the year a large part of the first volume, on the natural history and food-fishes of the United States, was in the hands of the printer, and to a considerable extent was stereotyped.

A large number of drawings was also made for the plates, and some of them reproduced by the photo-engraving process.

The volume will probably appear in the course of the year 1884.

Mr. Charles W. Smiley, Chief of the Division of Records, has had en-

tire charge during the year 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.

9.—PAYMENTS FOR ROYALTIES.

The question has frequently arisen on the part of the Commission as to the payment of royalties on patented articles used in connection with its operations, especially those of fish culture; the particular question being the demand of Mr. Oren Chase, of Detroit, for compensation for the alleged use of the principle of his fish-hatching jar. There is no question of authority to purchase an instrument or object, with the understanding that the price includes the royalty; but, in this instance, waiving the question of actual infringement of the patent, inquiry was made of the First Comptroller as to the authority to grant, under the circumstances, the request of Mr. Chase. After a careful consideration of the subject, he decided that the claim of Mr. Chase was of the nature of damages against the United States, and that the only remedy was in an application to Congress for compensation.

10.—PERMANENT SEA-COAST STATION OF THE UNITED STATES FISH COMMISSION.

From the inception of the work of the Commission, in 1871, it has been the custom to select some station on the sea-coast from which to prosecute the researches required by Congress into the scientific and economical problems connected with the sea and its inhabitants; the stations, as already indicated, covering the coast from the Bay of Fundy to Long Island Sound. In this way the peculiarities of the in-shores have been well determined, and the geographical distribution of the fishes, mollusks, crustaceans, radiates, etc., properly marked out. In addition to the discovery of a great many new species, much light has been thrown upon the subject of marine natural history generally.

It is not to be supposed that everything in this connection has been learned; but the broad features have been determined, and the remainder can be safely left to local and special researches.

The acquisition of a sea-going steamer, in the Fish Hawk, and the hope of obtaining a still more serviceable vessel, rendered it expedient to fix upon some point for permanent occupation where the necessary facilities could be obtained for doing the work of the Commission in the best manner.

As the same station was to be used, both for research, and for propagation of the marine fishes, and as the best conditions for the latter were found on the south coast of New England, fish here being in greater variety, and, so far as the winter hatching was concerned, the cold being much less severe, and the other circumstances generally more favor-

able, the region last mentioned was fixed upon. Although, so far as codfish are concerned, the fish are nearer the eastern coast of New England, still, by the use of a suitable fishing smack, they can be brought in alive from any reasonable distance and penned up until needed, and in this way exposed to much less danger from destruction by cold than was found to be the case when such work was prosecuted in Gloucester.

After a careful consideration of the subject, the choice was found to lie between two stations, Newport and Wood's Holl. Newport is much the more convenient of access, and its citizens manifested a great desire to secure the presence of the Commission. A committee, of which Mr. J. M. K. Southwick was spokesman, offered to furnish the necessary buildings and also the use of a suitable wharf, and otherwise to encourage the selection of that station. The Navy Department also gave the Commission a provisional invitation to establish itself on the northern end of Coasters' Harbor Island, a portion thought not to be required for the purposes of the Naval Training School. The great objection was found to be the comparative impurity of the water of Narragansett Bay, receiving, as it does, the drainage of a number of large cities, as Newport, Fall River, Bristol, Providence, etc., and having a large area of muddy bottom.

The experience of the year 1880 showed that the sediment settling, as it would, upon the eggs of the fishes to be hatched out, would materially impair their development, as was the case at Gloucester.

A totally different condition of things was found at Wood's Holl, where the water is exceptionally pure and free from sediment, and where a strong tide, rushing through the Wood's Holl passage, keeps the water in a state of healthy oxygenation specially favorable for biological research of every kind and description. The entire absence of sewerage, owing to the remoteness of large towns, as well as the absence of large rivers tending to reduce the salinity of the water, constituted a strong argument in its favor, and this station was finally fixed upon for the purpose in question.

The quarters occupied by the Commission at Wood's Holl, furnished by the courtesy of the Light-House Board, were too scanty for the enlarged work contemplated by the Commission, and measures were immediately instituted to obtain a foothold on the Great Harbor. Here a point of land, constituting the neck of the upper harbor, was fixed upon as a suitable location, affording the advantage of very deep water, accessible to vessels of ordinary dimensions, and immediately adjacent to the rapid tide of the passage. Negotiations were opened with the owners of the ground, Messrs. Isaiah Spindel & Co., and a provisional agreement made as to the price and the conditions of the purchase as referred to in the report of 1881.

The subscriptions of the various parties, to enable the Fish Commission to purchase the land at Wood's Holl required for the purpose of a

permanent fish-hatching and research station, and the donation of a large tract by Mr. J. S. Fay, were, of course, contingent upon the appropriation by Congress for the adjacent pier, and although this appropriation was made in 1882, it was not considered proper to call in the subscriptions and to definitely acquire possession of the money.

Mr. C. F. Choate, president of the Old Colony Railroad Company, and Mr. J. Malcolm Forbes, a summer resident of Naushon, were selected as trustees to whom the land was to be conveyed by the owners, Messrs. Isaiah Spindel & Co. and Mr. Joseph S. Fay, whenever the circumstances warranted it, the deeds of cession being made to the trustees with the proviso that on the claim either of the United States Fish Commissioner or of the Secretary of the Treasury there should be a transfer of the property to the United States.

As no permanent acquisition of ground can be made or accepted by the United States, unless full jurisdiction over the same (with the usual limitations) is ceded by the State, a resolution to that effect was accordingly passed by the legislature, and became a law by the signature of Governor John D. Long on March 30, 1882.

A general law was already in existence, authorizing the governor, without further formality, to cede jurisdiction over ground acquired by the United States Government for light-house purposes, custom-houses, or post-offices, and the Fish Commission was included with the parties specified. Thus, in case of future acquisition of land, it is only necessary under the law to make application to the governor for the cession thereof, and compliance with the requirement that a proper designation and plot of the tract be filed within a year of the receipt from the governor of the necessary documents. It is understood that this jurisdiction does not exclude the State officials from entering upon the land to serve a civil or criminal process.

It was suggested, in view of the expected acquisition and improvement of the ground at Wood's Holl for Government purposes, that the buildings which had been erected by Professor Agassiz on the island of Penekese in 1873, and which, since the abandonment of the island to its original owner, Mr. Anderson, had been unoccupied, might be properly transferred to Wood's Holl. I accordingly visited the locality for the purpose of making the necessary examination, but satisfied myself that, even if the buildings could be obtained free of cost, it would not be expedient to use them in the new station, the general requirements being so totally different, and the requisites not met by the buildings in question.

In order to possess data necessary for intelligent calculation in reference to grading and filling the Wood's Holl property, I secured the services of Mr. E. W. Bowditch, a well-known landscape architect and engineer of Boston, to make a careful survey of the premises. This he accordingly did and furnished a map on the scale of 20 feet to the inch,

with contour lines 1 foot apart over the entire surface of the greater part of Bar Neck. A reduced map of this, but somewhat extended in area, was made without contours, on a scale of 50 feet to the inch, corresponding in this respect to the scale of the hydrographic survey of the adjacent shores made by General Warren in 1881.

11.—CONGRESSIONAL ACTION IN REGARD TO THE WOOD'S HOLL STATION.

As explained heretofore, the carrying out of the extended plan for using Wood's Holl for a great central station for hatching sea fishes, such as cod, halibut, etc., depends upon an appropriation in the river and harbor bill for the construction of a harbor of refuge in the great harbor of Wood's Holl, to consist of a hollow pier, serving first to cover up and mask a reef of dangerous rocks; secondly, to protect the upper portion of the great harbor, and thus permit vessels of 20 feet draft to come in and remain in perfect safety in severe storms; and, thirdly, to furnish the basins for keeping the live fish.

The subject of an appropriation for a harbor of refuge was brought before the River and Harbor Committee of the House, and all the arguments in favor of the proposition were duly presented and sustained by Representatives Candler and Crapo, of Massachusetts, and other gentlemen interested in the commercial aspect of the plan. The signatures of business firms and insurance companies representing a capital of between one and two hundred millions of dollars, together with those of masters of many coastwise vessels, were obtained by Mr. John M. Gliddon, and brought before the committee in support of the measure, and, largely through the intervention of the gentlemen mentioned, especially of Mr. Candler, who was a member of the committee, an appropriation of $52,000 was obtained.

The magnitude of the amount appropriated by the river and harbor bill induced the President to defer action upon any new items in it until the subject could be recommitted to Congress for its consideration, work already under way alone receiving attention during the year. This, of course, was a very unwelcome interruption to the general labors of the Commission and retarded the completion of the plan for one year. It is hoped, however, that the embargo on the expenditure for Wood's Holl will be raised during the year, and that the work will be completed in 1883–'84.

No new development has occurred in connection with the acquisition of land for the purposes of the Commission. The subscriptions made by the various parties referred to in the report for 1881 were available only in the event of an appropriation by the Government for the collateral objects, and this being deferred everything has been held in abeyance during the year.

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

Having thus passed under review the most important features of the general work of the Commission during the year 1882, I now proceed to present more definitely the operations connected with the so-called "Inquiry Division" of the subject, embracing all that relates to the investigation into the actual condition of the inhabitants of the waters and their mutual relationships, as well as to the statistics of their abundance and capture, and the methods and apparatus by which they are, or may be, rendered subservient to the requirements of man.

The other branch of this work of the Commission relates to the increase of the supply of food-fishes generally, or in particular localities, by means of artificial propagation or by transplantation.

The investigations connected with the first branch of inquiry may be considered under several heads to be taken up in their order.

12.—THE SENATE COMMITTEE ON INVESTIGATION OF THE MENHADEN FISHERIES.

The many complaints, by citizens of New Jersey, of the destruction of the menhaden by purse and pound nets involving an inability of the fishermen to secure sufficient bait for line fishing, as also the assertion that large numbers of valuable food-fishes were destroyed by these agencies, induced the reference of the several memorials and petitions to a subcommittee of the Senate Committee on Foreign Relations; this reference having been made on the ground that any legislation in regard to the inshore fisheries would necessarily have a very definite relationship to the provisions of the fisheries clause of the Washington treaty which went into effect in 1873.

The subcommittee named consisted of Mr. Lapham as chairman, with Messrs. Edmunds, Miller of California, Morgan, and Windom as members.*

The United States Fish Commission was instructed to render to this subcommittee any assistance in its power.

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*The following are the Senate resolutions under which action has been taken:

"*Resolved*, That five members of the Committee on Foreign Relations of the Senate be designated by the chairman of said committee as a subcommittee to act in conjunction with the Commissioner of Fish and Fisheries to examine into the subject of the protection to be given by law to the fish and fisheries of the Atlantic Coast, as proposed in the bill (S. No. 1823) for the protection of fish and fisheries on the Atlantic Coast.

"*Resolved*, That said committee have power to send for persons and papers in regard to the before-mentioned inquiries, and that it have leave to sit during the recess of the Senate.

"*Resolved*, That the expenses incurred in the execution of the foregoing resolutions be paid on the certificate of the chairman of said subcommittee out of the appropria- for the contingent expenses of the Senate."

The subcommittee took up its work immediately after the adjournment of Congress, and visited a number of the towns on the coasts of New Jersey, New York, Connecticut, and Rhode Island, taking a large amount of testimony from both sides in the controversy.

The Commission placed the Lookout at the command of the committee, and, at various times, Major Ferguson and Colonel McDonald, of the Commission, were in attendance and rendered such help as they could.

Quite a number of witnesses were examined in Washington, being summoned there for the purpose.

The subcommittee did not consider it expedient to make a report of its work for 1882, preferring to devote another session to the special inquiry.

13.—THE WORK OF THE FISHERY CENSUS OF 1880, AND ITS RESULTS.

In my report for 1879* it was announced that arrangements had been made to co-operate with the Superintendent of the Tenth Census in collecting the statistics of the fisheries of the United States. In subsequent reports the progress of the work has been frequently alluded to, and the principal features of the plan described.

The work is still in progress, the delay in printing the reports, although vexatious, affording an opportunity for a more careful elaboration of the material than would otherwise have been practicable. The alliance between the Census and the Fish Commission, so far as financial interests are concerned, having come to an entire close during the year, it seems appropriate to review at this time the history and present condition of the undertaking.

In July, 1879, an arrangement was made with General Francis A. Walker, Superintendent of the Tenth Census, by which an investigation of the fisheries of the United States was undertaken as the joint enterprise of the United States Fish Commission and of the Census Bureau. It was decided that this investigation should be as exhaustive as possible, and that both the United States Fish Commission and the Census should participate in its results. The preparation of a statistical and historical description of the fisheries, to form one of the series to be presented by the Superintendent of the Census in his report, was from the first the main object of the work, but in connection with extensive investigations into the methods of the fisheries, into the distribution of the fishing-grounds, and the natural history of useful marine animals were carried on.

The direction of this investigation was placed in the hands of Mr. G. Brown Goode, who was appointed a special agent of the Census Office,

* Report of Commissioner. Part VII, 1879 (1882), pp. XXIII-VII. *Ibid.* Part VIII, 1880 (1883), pp. XXVII, 1-62. *Ibid.*, Part IX, 1881 (1884), pp. XXXI-II. Report of Secretary of Smithsonian Institution, 1880 (1882), pp. 78-9. *Ibid.*, 1881 (1883), pp. 51-3. *Ibid.*, 1882 (1883), p. 55.

and who has since been carrying on this work in addition to the performance of his duties in connection with the National Museum and the Fish Commission.

The plan of the investigation was drawn up before the beginning of the work, and was 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; also, as above stated, in Part VIII of this report.

The scheme of investigation divided the work into the following departments:

I.—NATURAL HISTORY OF MARINE PRODUCTS.

Under this head was to be carried on the study of the useful aquatic animals and plants of the country, as well as of seals, whales, turtles, fishes, lobsters, crabs, oysters, clams, etc., sponges and marine plants and inorganic products of the sea, with reference to (A) Geographical Distribution; (B) Size; (C) Abundance; (D) Migrations and Movements; (E) Food and Rate of Growth; (F) Mode of Reproduction; (G) Economic Value and Uses.

II.—THE FISHING-GROUNDS.

Under this head were studied the geographical distribution of all animals sought by the fishermen, and the location of the fishing-grounds; while with reference to the latter are considered: (A) Location; (B) topography; (C) depth of water; (D) character of bottom; (E) temperature of water; (F) currents; (G) character of invertebrate life, etc.

III.—THE FISHERMEN AND FISHING TOWNS.

Here were to be considered the coast districts engaged in the fisheries, with reference to their relation to the fisheries, historically and statistically, and the social, vital, and other statistics relating to the fishermen.

IV.—APPARATUS AND METHODS OF CAPTURE.

Here were to be considered all the forms of apparatus used by fishermen, boats, nets, traps, harpoons, etc., and the methods employed in the various branches of the fishery. Here each special kind of fishery, of which there are more than fifty in the United States, is considered separately with regard to its methods, its history, and its statistics.

V.—PRODUCTS OF FISHERIES.

Under this head were to be studied the statistics of the yield of American fisheries, past and present.

VI.—PREPARATION, CARE OF, AND MANUFACTURE OF FISHERY PRODUCTS.

Here were to be considered the methods and the various devices for utilizing fish after they are caught, with statistics of capital and men

employed, etc.: (A) Preservation of Live Fish; (B) Refrigeration; (C) Sun-drying; (D) Smoke-drying; (E) Pickling; (F) Hermetically Canning; (G) Fur Dressing; (H) Whalebone Preparation; (I) Isinglass Manufacture; (K) Ambergris Manufacture; (L) Fish Guano Manufacture; (M) Oil Rendering, etc.

VII.—ECONOMY OF THE FISHERIES.

Here were to be studied (A) Financial Organization and Methods; (B) Insurance; (C) Labor and Capital; (D) Markets and Market Prices; (E) Lines of Traffic; (F) Exports, Imports, and Duties.

The fishery industry is of such great importance, and is undergoing such constant changes, that a visit of a few days or weeks to any locality, even by the most competent experts, has invariably proved unsatisfactory. We have therefore been able to collect only the most important facts, selected with special reference to the needs of the report in contemplation, leaving many subjects of interest untouched.

The field-work and the correspondence in connection with it were carried on by the following-named special agents, and approximately between the dates below mentioned:

I. Coast of Maine, east of Portland: Mr. R. E. Earll and Capt. J. W. Collins, August 1 to October 31, 1879; July 29 to October 20, 1880; January 1, 1881 to January 1, 1883.

II. Portland to Plymouth (except Cape Ann) and eastern side of Buzzard's Bay: Mr. W. A. Wilcox, September 2, 1879, to March 1, 1881.

III. Cape Ann: Mr. A. Howard Clark, September 1, 1879 to November 1, 1880; July, August, and September, 1883.

IV. Cape Cod: Mr. F. W. True, July 1 to October 1, 1879; September 1 to October 31, 1880; Mr. Vinal N. Edwards, October 1, 1880, to July 31, 1882.

V. Provincetown: Capt. N. E. Atwood, August 1, 1879, to August 1, 1880.

VI. Rhode Island and Connecticut, west to the Connecticut River: Mr. Ludwig Kumlien, August 16 to October 16, 1880.

VII. Long Island and north shore of Long Island Sound and west to Sandy Hook: Mr. Fred Mather, August 1, 1879, to July 1, 1881.

VIII. New York City: Mr. Barnet Phillips, January 1, 1880, to July 1, 1881.

IX. Coast of New Jersey: Mr. R. E. Earll, December, 1880.

X. Philadelphia: Mr. Chas. W. Smiley and Mr. W. V. Cox, November, 1880.

XI. Coast of Delaware: Capt. J. W. Collins, December, 1880.

XII. Baltimore and the Oyster Industry of Maryland: Mr. R. H. Edmonds, October 1, 1879, to October 1, 1880.

XIII. Atlantic coast of Southern States: Mr. R. E. Earll, January 1 to July 25, 1880.

XIV. Mexican Gulf coast: Mr. Silas Stearns, August, 1879, to July, 1880.

XV. Coast of California, Oregon, and Washington: Prof. D. S. Jordan and Mr. C. H. Gilbert, January, 1880, to January, 1881.

XVI. Puget Sound: Mr. James G. Swan, January, 1880, to January, 1881.

XVII. Alaska Fisheries: Dr. T. H. Bean, June to October, 1880.

XVIII. Great Lakes Fishery: Mr. Ludwig Kumlien, August, 1879, to August, 1880.

XIX. River Fisheries of Maine: Mr. C. G. Atkins, January 1, 1880, to July 3, 1882.

XX. The Shad and Alewife Fisheries: Col. Marshall McDonald, October, 1879, to January 1, 1883.

XXI. Oyster Fisheries: Mr. Ernest Ingersoll, October 1, 1879, to July 1, 1881. (?)

XXII. Lobster and Crab Fisheries: Mr. Richard Rathbun, January 1, 1880, to January 1, 1882.

XXIII. Turtle and Terrapin Fisheries: Mr. F. W. True, October 1, 1880, to January 1, 1882.

XXIV. The Seal, Sea-Elephant, and Whale Fisheries: Mr. A. Howard Clark, November 1, 1880, to February 1, 1881.

In addition to the field assistants already mentioned, a staff of office assistants was employed in carrying on correspondence, searching past records, and preparing the report for publication. Mr. Chas. W. Smiley, Mr. James Temple. Brown, and Mr. G. S. Hobbs were connected with the work from its start, and from a later date Mr. J. E. Rockwell, Mr. C. W. Scudder, Mr. R. I. Geare, Mr. George P. Merrill, and others were thus employed. A number of clerks have also been detailed for this work by the Superintendent of the Census, at one time as many as twenty.

A large part of the clerical force was under the direction of Mr. Chas. W. Smiley, who had in special charge the distribution of circulars and the compilation of their results, and the compilation of summary tables from the records of the Treasury Department.

The expense of the field-work from July 1, 1879, to July 1, 1881, was for the most part borne by the Census, together with that of a large amount of compilation office work carried on by clerks detailed from the Census Office in Washington.

The expense of 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 in the capacity of a volunteer; his services in the preparation of the reports and in connection with their publication, having 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 done as volunteer labor by officers of the National Museum and Fish Commission in addition

to their regular duties. A number of employés of the Fish Commission have been 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, worded as follows, which passed the Senate July 16, 1882:

"*Resolved by the Senate (the House of Representatives concurring)*, That the Public Printer be, and is hereby, instructed to print, in quarto form, a report by the United States Commissioner of Fish and Fisheries upon the food-fishes and fisheries of the United States, the engravings to be in relief, and to be contracted for by the Public Printer under the direction of the Joint Committee on Printing, and to receive the approval of the Commissioner before being accepted; the work to be stereotyped, and 10,000 extra copies printed, of which 2,500 shall be for the use of the Senate, 5,000 for the use of the House, and 1,500 for the use of the Commissioner of Fish and Fisheries. There shall also be printed 1,000 extra copies for sale by the Public Printer, under such regulations as the Joint Committee on Printing may prescribe, at a price equal to the additional cost of publication, and 10 per cent. thereon added."

The manuscript for this report is, in the main, 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 is now well advanced toward completion. The contents of the report, it is proposed, shall be as follows:

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

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

PART I.—The Natural History of Useful Aquatic Animals.
II.—The Fishing Grounds.
III.—The Fishing Towns, containing a geographical review of the Coast, River, and Lake Fisheries.
IV.—The Fishermen.
V.—The Apparatus of the Fisheries, and Fishing Vessels and Boats.
VI.—The Fishery Industries, a discussion of methods and history.
VII.—The Preparation of Fishery Products.
VIII.—Capital and Labor as employed in the Fisheries.
IX.—Fish Culture, Fishery Laws, and Fishery Legislation.
X.—Statistics of Production, Exportation, and Importation. Summary Tables.

PART XI.—The Whale Fishery—a special monograph.
XII.—The Aboriginal Fisheries.
XIII.—A Catalogue of the Useful and Injurious Aquatic Animals and Plants of North America.
XIV.—A List of Books and Papers relating to the Fisheries of the United States.

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 manufacture.
II.—A Review of the Fisheries of the Pacific Coast, with statistics of production and manufacture.
III.—A Review of the Fisheries of the Great Lakes, with statistics of production and manufacture.
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.)
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. (Prepared under the direction of Mr. C. W. Smiley.)
VIII.—List of the Fishing vessels of the United States in 1880, giving tonnage, value, number of crew, name of owner, branch of fishing 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.)

The above-mentioned parts will furnish an estimated aggregate of 1,030 pages, quarto, exclusive of the matter already in type. The manuscript of Parts I, II, III, IV, VII, IX, and X, has already been delivered. Parts V, VI, and VIII are held for final revision, but are essentially complete.

The material specified in the last paragraph 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:

Census Bulletin (1) No. 176.
(Preliminary Report upon the Pacific States and Territories); prepared by Mr. G. Brown Goode from returns of Special Agents Jordan, Swan, and Bean. Dated May 24, 1881. 4to, pp. 6 (x 2.).

Census Bulletin (2) 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.

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

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

Census Bulletin (5) 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).

Census Bulletin (6) 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).

Census Bulletin (7) 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.)

Census Bulletin (8) No. 298.
Commercial Fisheries of the Southern Atlantic States; prepared Mr. R. E. Earll and Col. 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.

Table showing by States the persons employed, capital invested, and value of products in the oyster industry.

(10) Statistical Table.

Statistics of the Fisheries of the United States in 1880; prepared by Messrs. Goode and Earll from the reports of the Special Agents. Printed in the Compendium of the Tenth Census, p. 1402. pp. 2. Reprinted in Bulletin of the United States Fish Commission, Vol. III, 1883, pp. 270–'1, in Preliminary Catalogue International Fisheries Exhibition facing p. 5.

(11) 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 United States Fish Commission, Part VIII, 1880, p. 416.

(12) Statistical Summary.

(Statistics of the Davis Strait Halibut Fishery.) By Newton P. Scudder. Report United States Fish Commission, Part VIII, pp. 190–192.

(13) Statistical Summary.

(Statistics of the Sword-fish Fishery.) By G. Brown Goode. Report United States Fish Commission, Part VIII, pp. 361–'7.

(14) Statistical Summaries.

Statistics of the Mackerel Fishery in 1880. By R. Edward Earll. Report United States 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).

(15) Statistical Summary.

(Statistics of the use of Fish Guano as a fertilizer.) By Charles W. Smiley. Report United States Fish Commission, Part IX, pp. 673–693.

(16) Statistical Summary.

(A Statistical review of the production and distribution to public waters of young fish by the United States Fish Commission from its organization in 1871 to the close of 1880.) By Charles W. Smiley. Report United States Fish Commission, Part IX, pp. 826–842.

Two special reports have also been published, as follows:

(17) A Monograph of the Seal Islands of Alaska. By Henry W. Elliott. 4to, illustrated. pp. 172. An addition of this report with substitutions on pp. 102–109 was also issued as a Special Bulletin of the Fish Commission, No. 176.

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

The general results of the investigations from the statisticians' standpoint may be briefly summarized as follows:

In 1880 the number of persons employed in the fishery industries of the United States was 131,426, of whom 101,684 were fishermen and the remainder shoremen. The fishing fleet consisted of 6,605 vessels (with a tonnage of 208,297.82) and 44,804 boats, and the total amount invested was $37,955,349, distributed as follows: Vessels, $9,357,282; boats, $2,465,393; minor apparatus and outfits, $8,145,261; other capital, including shore property, $17,987,413.

The value of the fisheries of the sea, the great rivers, and the great lakes was placed at $43,046,053, and that of those in minor inland waters at $1,500,000; in all, $44,546,053. These values were estimated upon the basis of the prices of the products received by the producers, and if average wholesale prices had been considered the value would have been much greater. In 1882 the yield of the fisheries was much greater than in 1880, and prices, both "at first hand" and at wholesale, were higher, so that a fair estimate at wholesale market rates would place their value at the present time rather above than below the sum of $100,000,000.

The fisheries of the New England States are the most important. They engage 37,043 men, 2,066 vessels, 14,787 boats, and yield products to the value of $14,270,393. In this district the principal fishing ports in order of importance are: Gloucester, Portland, Boston, Provincetown, and New Bedford, the latter being the center of the whale fishery.

Next to New England in importance are the South Atlantic States, employing 52,418 men, 3,014 vessels (the majority of which are small and engaged in the shore and bay fisheries), 13,331 boats, and returning products to the value of $9,602,737.

Next are the Middle States, employing in the coast fisheries 14,981 men, 1,210 vessels, 8,293 boats, with products to the amount of $8,676,579.

Next are the Pacific States and Territories, with 16,803 men, 56 vessels, 5,547 boats, and products to the amount of $7,484,750. The fisheries of the Great Lakes employ 5,052 men, 62 vessels, and 1,594 boats, with products to the amount of $1,784,050. The Gulf States employ 5,131 men, 197 vessels, and 1,252 boats, yielding products to the value of $545,584.

14.—INVESTIGATION OF THE ALLEGED DESTRUCTION OF THE TILE FISH.

In preceding reports mention has been made of the tile-fish (*Lopholatilus chameleonticeps*), which was discovered by Captain Kirby in May, 1879. It was described by the ichthyologists of the Fish Commission, and subsequently specimens were captured by the steamer Fish Hawk, August 8, 1880, and again in 1881. During March and April, 1882, vast numbers of dead tile-fish were seen floating in the Atlantic Ocean over an area extending for 38° 4′ to 40° 25′ north latitude and between 69° 50′ and 73° 15′ west longitude. Captain Collins has made a report upon this subject, which will be found in the appendix to this volume.

In order to ascertain the extent of this mortality, the schooner Josie Reeves, of New York, was chartered by the Fish Commission from September 18 to September 24, 1882. On the former date, with Capt. J. W. Collins and Mr. Barnet Phillips on board, the Josie Reeves, Captain Redmond in command, left Greenport for the tile-fish grounds. Considerable difficulty and some delay were experienced in getting a supply of menhaden for bait. In the afternoon of the 20th a locality was reached where tile-fish had been found in abundance during the Fish Hawk's second visit of August 23, 1881. This was at 40° 4′ north latitude and 70° 30′ west longitude. The next morning trawls were set in 160 fathoms. Three fish were taken, but none of them were tile-fish. During Thursday, Friday, and a part of Saturday trawls were set in a variety of places—along a range of 50 miles—without securing a specimen of the fish under quest. The unpropitious state of the weather prevented a longer continuance of the search. Captain Collins became satisfied, however, that the tile-fish was not to be found in that region. A full report of the cruise of this vessel has been made by Captain Collins, and has been published in the Fish Commission Bulletin for 1882, Vol. II, pp. 301–310.

After using every possible effort to reach a conclusion, the party returned to Wood's Holl, reporting the entire absence of the fish on the ground where, doubtless, a year before, hundreds might have been taken with the same amount of effort. The search was rewarded, however, by the discovery of a second fish of very excellent quality, belonging to the genus *Setarches*, but closely related to the genus *Sebastes*. Small specimens had been previously taken by the Fish Hawk, but these in question, amounting, as they did, to several pounds in weight, indicated their existence of commercially available size.

15.—THE POLE FLOUNDER.

It will be remembered that in previous reports reference has been made to the discovery, by the United States Fish Commission, in vast numbers, off the eastern coast of New England, of the Pole Flounder—*Glyptocephalus cynoglossus*. This is believed to be more abundant in that re-

gion than any other species of its family; but it can only be taken by the beam trawl, the smallness of its mouth preventing the use of the ordinary baited hook.

During the explorations of the summer from Wood's Holl large quantities of this species were captured in localities very far to the south of the region where first discovered; and specimens were sent to Mr. Blackford, at New York, to be submitted to experts and connoisseurs as to their edible qualities. A unanimous approval was given of the fish as being of remarkable excellence, and as in no way inferior to the English sole in its best condition.

16.—MODELS OF THE FISHING-GROUNDS.

Professor Hilgard, of the United States Coast Survey, several years ago kindly undertook the supervision of the construction by Mr. Lindenkohl of a model to show the fishing banks of the eastern coast of New England, including the Grand Banks of Newfoundland. This constituted one of the most interesting American objects at the Berlin Fishery Exhibition.

Desirous of showing some of these banks on a larger scale, a similar arrangement was made with Professor Hilgard for the construction by Mr. Lindenkohl of a model of the Gulf of Maine for exhibition at the London Fishery Exposition. The Coast Survey itself had prepared by Mr. Lindenkohl a model of the entire eastern coast of the United States and the Gulf of Mexico with the special view of showing the depth of the basin of the Gulf Stream as developed by the more recent researches of the Blake.

It is expected that these several models will be very prominent features of the London Exhibition.

17.—FUNGUS DISEASES OF FISH.

The subject of the fungus disease which attacks fish, especially the fresh water salmonidæ, is one of great importance, in view of the very serious injury that has been done to the British salmon fishery by this agency. An elaborate report on this subject, made to the British Government by Professor Huxley, has been republished by the Commission; but as the conditions in American waters and with American species may be somewhat different, Dr. Farlow has kindly undertaken an investigation of the subject in the interest of the United States Fish Commission. As material becomes procurable it will be forwarded to Dr. Farlow for this purpose.

18.—WORK DONE AT WOOD'S HOLL IN 1882.

In a preceding part of this report will be found an account of the measures taken to establish, at Wood's Holl, a permanent station for prosecuting investigations into the fisheries, and for the propagation of marine fishes.

In spite of the impossibility of commencing work during 1882 in the construction of the permanent station, it was determined to make Wood's Holl again the headquarters of the general work of the Commission, and as a large number of persons were expected to join the party during the summer, it became necessary to make special arrangements for their accommodation. The hotel which constituted the headquarters of the Commission for the year 1881 was closed, and it became necessary for the Commissioner to lease it. Before possession could be taken, however, the building was burned to the ground on the 16th of May, but by the kind assistance of Mr. Joseph S. Fay, of Wood's Holl, the building used in 1881 for the assistants of the Commission was fitted up as headquarters, and a second building obtained for offices. Most of the party were billeted in different rooms throughout the village. A steward was employed in Washington, who carried with him the necessary corps of assistants, and a general mess for the entire party was kept in the headquarters building. This arrangement was found to be quite satisfactory, although involving more or less inconvenience.

I left Washington on the 27th of July, and reached Wood's Holl on the 28th, a special car from Fall River to Wood's Holl having been furnished by President Choate, of the Old Colony Railroad Company, for the accommodation of several invalids.

The Fish Hawk arrived on the 26th of July.

As heretofore the marine invertebrate work was under the direction of Prof. A. E. Verrill, who had as his assistants Messrs. Emerton, Sanderson Smith, Bruner, Linton, Koons, etc. The fishes were cared for for by Peter Parker, jr., and Mr. Miner. A portion of the office staff also accompanied me, consisting of Messrs. H. A. Gill, J. P. Wilson, and Edward Hayes.

The Fish Hawk made several trips to the Tile-fish ground, for the special purpose of determining whether the destruction of the tile-fish referred to in another part of the report was as extensive as reported. The results will be found under the head of the Tile-fish.

In view of the the fact that many species of deep-sea fishes collected by the Fish Hawk had previously been taken under the supervision of Mr. Agassiz, by the Coast Survey steamer Blake, an arrangement was concluded with that gentleman by which all the species of this character, collected by the Fish Hawk, would be worked up by Mr. G. Brown Goode and Dr. Tarleton H. Bean conjointly, and a provisional report published, first in the Bulletin of the Museum of Comparative Zoölogy, followed by an illustrated paper in the Memoir. This has, accordingly, been done, and a valuable addition to science has been the result.

19.—INVESTIGATION OF THE FISHES OF THE ADIRONDACK REGION.

In connection with the proposed exploration by Dr. C. Hart Merriam, of the natural history of the Adirondack region, an arrangement was

made with him to secure a series of the fishes, for the purposes of the Commission, and the necessary alcohol being provided, a very interesting collection was made by him. He will himself prepare a report on the subject for publication.

C.—PROPAGATION AND INCREASE IN SUPPLY OF FOOD-FISHES.

20.—BY PROTECTIVE MEASURES ENFORCED WHEN NECESSARY BY LAW.

As explained in previous reports, the duty first assigned by Congress to the United States Fish Commission was that of investigating the condition of the fisheries of the rivers, lakes, and seas of the United States, as compared with that in former years, and of suggesting measures for protecting and increasing the supply. It was not until the second year, or 1872, that the subject of the propagation of the food-fishes was added. This division of the work, however, has increased year by year, until now it represents by far the largest portion of the expenditure.

Preventing willful and wasteful destruction of adults or young.—There are a number of methods by which the increase in the supply of fishes in a given region can be brought about. The simplest of these is the avoidance of their capture at improper times and of their willful destruction. All desirable fishes should be spared as much as possible during the spawning season, as it is at such times that they are exposed to special danger. A fish that has safely escaped to the period when the eggs and milt are ripe for the purpose of propagation should be permitted to perform that function without interference. Of course, after the eggs are deposited with the assurance of their development and the growth of the young, the parent fish cease to be of any serious moment, especially as one act of spawning is all that many kinds ever perform. When taken, however, before spawning, the expectancies of future yield are necessarily nullified. Legislation in this direction has been directed more particularly to the protection of the salmon and the trout; the close time usually beginning a month or two before the ripening of the eggs.

In the case of shad the prohibition of capture after some date in June has been found very serviceable.

Exclusion of poisonous or injurious waste from the waters.—Another method of securing an increase consists in taking the necessary measures to prevent the introduction of foul waste, such as will either kill or injure the adult fish or young, or interfere with the development of the eggs. Under this head may be mentioned poisonous matters from factories, such as paper and dyeing establishments, and gas and ammonia works; also the refuse of saw-mills, the saw dust getting into the gills of the parent fish, or else covering up the spawning beds, so that these will not discharge their proper functions.

Removal of obstructions to the movements of fish and of injurious engines of capture.—A third method of favoring the natural increase of fish consists in removing the natural or artificial obstructions to the ascent of the fish from the lower to the higher waters of a stream, or their descent in the opposite direction. Spawning fish, notably the shad, the fresh-water herring, and the salmon, enter the mouths of rivers from the sea at the appointed time and find their spawning ground at various points on the river, the herring low down, the shad in the medium districts, and the salmon more toward the head. The interposition of artificial dams, unsurmountable by the fish, has been a great and perhaps the chief factor in diminishing the supply in this class of fish, as with the erection of a dam, especially near the mouth of a stream, the spawning fish ascending are arrested, and are either turned back from their course or else fail to find a suitable place or opportunity to deposit fertilized eggs. For the first two or three years there will be a continually lessening of the run of the fish. At the end of this time, however, or when all the fish born in that stream have been caught or destroyed, the run ceases, and after that, even though the obstruction be removed, the river will remain practically barren of fish until restocked by human agencies.

Again, even in many cases where the adult fish succeed by their own efforts, or by the use of fishways, in getting to the headwaters of the rivers, the progeny is destroyed in enormous quantity by the so-called fish-baskets or weirs, which take the young by myriads. The most potent agents in this respect are the eel traps or dams, which consist for the most part of two converging lines of stone walls, with the apex pointing downwards, and ending in a so-called fish basket. Here eels, upon their descent to the salt water, are taken in great quantities, and with them the young of shad, salmon, bass, etc.

It may safely be stated that nothing has done more to diminish the number of adult fish, and prevent their increase in our waters, than this engine of destruction. Nothing short of absolute removal and prohibition of such "fish-baskets" will answer the purpose; although, of course, such prohibition will interfere with the take of the much desired eels. Still the interests of an entire community should be considered paramount to those of a few farmers living near the streams in question. The other obstructions, whether natural or artificial, constitute a factor in some instances greater than the fish-baskets, and sometimes less. There are many streams, such as the Susquehanna and the Delaware, where the parent or spawning fish can, under favorable circumstances, make the ascent and deposit their eggs—the young fry, however, to be caught by the fish-baskets. In other cases, where the passage upward is barred by the obstruction in question, the fish-baskets are of less importance, as being confined in their action to a smaller number of species. The young eels coming up from the ocean in the spring, can make

their way up an obstruction unsurmountable by the shad, or even by the salmon; so that there are very few waters in the eastern portion of the United States where descending eels cannot be captured.

All these methods of protection of fish and of enabling them to carry out their mission, whether adults or young, are usually the subjects of legislation; and in some countries very stringent laws are in existence, and enforced by the constant vigilance of wardens.

The general principles just presented have relation for the most part to the protection of the fish, and to the enabling them to perform their reproductive functions undisturbed at the critical time.

Erection of fish-ways.—It is not my purpose at present to go into the more detailed discussion of the various methods of protection of fish, or into the question of suitable laws to establish such protection; but I confine myself to the subject of "fish-ways," which has always occupied a good part of the attention of the Commission.

In the report for 1872–'73, pp. 591–616, I have published an elaborate account of the different methods of constructing fish-ways for facilitating the ascent of fish over obstructions in the rivers, including all that were known, or in common use, at the time, and some which were devised by assistants of the Commission.

Numerous forms of fish-ways have been more or less successful, especially in connection with the movements of the salmon. This fish is very vigorous, and able, by leaping, to surmount vertical falls of quite a number of feet in altitude, the number varying with the strength of the fish. No height less than 6 or 8 feet is believed to be insuperable to the salmon; but other fishes, especially the shad, are less powerful, and for these fish-ways are needed in many cases where they are not necessary for salmon.

It is but fair to state that, so far, the ordinary methods of fish-ways have not been successful in facilitating the upward run of the shad, and in spite of a great deal of ingenuity and much expenditure of money and experiment, the problem cannot yet be considered as entirely solved.

The device of Col. Marshall McDonald, one of the principal assistants of the United States Fish Commission, holds out very great promise of success in this respect, and it is proposed to test this apparatus at the Great Falls of the Potomac River, Congress having made an appropriation for the purpose.

There is no locality where a successful fish-way would do more in the way of increasing the supply of shad than on the Potomac River, as the stream below the Great Falls now represents a most productive locality for shad, and the waters above the Falls would furnish the most favorable opportunities imaginable for the spawning of eggs and development of the young. The general character of the device selected will be found under the head of the Great Falls Fish-way.

21.—BY ARTIFICIAL AGENCIES.

The other division of the subject relates to the actual stocking of the waters artificially, either by transfer from one locality to another or by the introduction of eggs artificially impregnated, or of young fish, the results of hatching these eggs after being impregnated. It is a very serious question which of these two great divisions, protection or propagation, is the more important. In some cases preference would be given to the one, and in some to the other. Either method alone is largely insufficient; it is the combination of the two that gives us the best results.

Transplanting of fish from one region or locality to another.—By this term I refer to fish that have been born in the waters by the natural process and transferred to distant points. Sometimes this is done accidentally, as when fish-ponds are broken down by floods, and the fish are carried into larger waters. More generally, however, this term represents a special feature of the service of many of the western State Fish Commissions.

The high floods of the spring and summer frequently carry into the adjacent fields or prairies great numbers of fish, which, as the waters recede, are left, either in these localities or in bayous belonging to the main stream, to perish. Many millions of fish are annually destroyed in this way. The State commissions, however, have aided greatly in preventing the loss, by carefully gathering up the young fry as well as the adults, thus concentrated, and returning them to the main river.

Artificial propagation.—The method of intentional transplantation just referred to is very important in its way, and should be carried out as largely as possible. It is, however, to the artificial propagation of the fish, whether of the lakes, the rivers, or the ocean, that we may look with the greatest assurance of a profitable result. There is no doubt that many serious disappointments have been experienced as the result of work actually initiated in this direction, and the hopes not only of a rapid recovery from depletion, but also of an increase in the supply, have in many cases been entirely blasted; so that at the present time it may safely be said there is much less enthusiasm as to the results than before.

Failures have resulted in a large degree from the limited scale on which the work has been carried out. If the expectancy of destruction in a given locality be estimated as representing one million young fish, and any number *less* than one million be introduced therein, it is easy to understand that there will be no result.

In the earlier days of the Fish Commission large quantities of eggs and young were unprocurable, and it was only by gradual processes that the spawning fish were multiplied sufficiently to answer the purpose in question. This, however, has been accomplished in the case of the shad and some other species, so that where six or eight years ago

one messenger could carry all the young procurable in a given time, a car holding ten or twenty times that amount is at present easily filled.

Too much, however, must not be expected from artificial propagation, as it has to contend, not only with the depletion by excessive fishing, but also with changes of physical condition, such as temperature, etc., that require increased efforts to meet and overcome, and possibly, in some instances, the substitution of other species better able to resist the changes in question. In some cases the preventable difficulties mentioned above successfully antagonize all the efforts made.

22.—NEED OF A FISH-WAY AT THE GREAT FALLS OF THE POTOMAC.

The importance of maintaining at their maximum of production the valuable fisheries of the Potomac can hardly be over-estimated, in view of the extent to which they furnish food for home consumption and for transportation, and also of their agency in reducing the expense of living to the poorer portion of the population. The fish involved in this consideration are the shad, herring, rock, white perch, and black bass, together with other fish coarser in quality and lower in price.

Old records dating back to colonial times bear testimony to an abundance of production, which, read in the light of present experience, seems little short of marvelous, although after all credible when we consider the favorable conditions for natural production which were then afforded.

The broad estuary of the Potomac River, extending for a distance of more than 100 miles, from Point Lookout to the Great Falls, offered through its whole length numerous flats and bars where the shad could spawn, rarely molested by the intrusion or device of man. Its reedy shores and extensive tracts of marsh land, covered with aquatic grasses, furnished everywhere a nidus and a nursery for the countless million of eggs of the glut herring (*Pomolobus aestivalis*).

Into the numerous creeks tributary to the main river, which have their origin in the swamps of the interior, the branch herring (*Pomolobus vernalis*) entered to find at their sources a suitable resting place for its eggs and a safe habitat and temporary abiding place for its young.

How the hand of man has changed all this will be evident from the following considerations: Access to the sources of the smaller tributaries of the Potomac, which drain the tide-water region, has been almost universally barred by mill-dams placed at the head of tide. The conversion of the woodland along their banks into arable fields has rendered turbid their once clear waters, and with every rain a muddy torrent is sent down, loaded with fine sediment, which settles upon and stifles every embryo of shad or herring which may have found a resting place in the reaches below tide level. In addition, fykes and stake nets, weirs and pound or trap nets bar access of mature fish to these streams almost as effectually as the dams prevent their ascent.

In the main river the favorable natural conditions which formerly ex-

isted have disappeared before the encroachments of man. Cities have grown up along its banks which each year discharge into its waters an increasing volume of sewage, gas tar, and other deleterious substances to pollute the water and render it unfit for healthy development of the eggs that may be deposited. Large seines occupy every reach where the fish congregate to spawn, or stretch their broad arms across the channel to intercept the schools of shad and herring in their upward migrations. From every headland pound nets stretch their meshes a thousand feet or more from shore to guide the unwary fish into the traps, which are set on the edge of, and often in, the navigable channel.

Hundreds of gillers, with nets a hundred fathoms long, stretched across the channel, drift up and down, on ebb and flood, unceasingly, and with their fine-spun nets, almost invisible, obstruct ascent as effectually as if strong dams of stone or timber barred the passage.

Such being the condition of things on the Potomac at the present time, the conclusion was readily reached that if the spawning grounds of the shad and herring could be enlarged by taking in the long reaches of river that lie above the Great Falls a great gain could be secured. This, however, could only be done by providing convenient passage for them over or around this obstruction.

Accordingly, when the necessity of an increased water supply for the city of Washington was brought before Congress by the Commissioners of the District of Columbia, I addressed a letter to Maj. W. J. Twining, then Engineer Commissioner of the District, calling his attention to the propriety of including, in any proposition for the completion of the dam at the Great Falls, the construction of a suitable fish-way to admit the ascent of shad, salmon, striped bass, herring, sturgeon, etc., to the upper waters of the Potomac River. Subsequently, in response to the invitation of the Committee on the District of Columbia in the House of Representatives, I addressed them the following communication:

UNITED STATES COMMISSION FISH AND FISHERIES,
Washington, D. C., June 1, 1882.

Hon. HENRY S. NEAL,
Chairman Committee on District of Columbia,
House of Representatives:

DEAR SIR: In response to the inquiries made by your committee through the Hon. Mr. Garrison, I would submit the following:

In 1871, in compliance with an act of Congress, I was designated by the President to conduct an inquiry into the causes operating to diminish the supply of food-fishes on the sea-coast and the lakes of the United States. The investigations had made but little progress before I became convinced that the obstructions in our rivers, whilst not the only cause, were one of the main factors in determining the reduction in the numbers both of the anadromous fishes, such as the salmon, shad, and herring, and the salt-water species, the food of which consists largely of the anadromous species referred to. In the case of the salmon, shad, and herring (alewives) the effect was direct and immediate. The obstructions in some rivers have entirely excluded these fishes from their

spawning grounds, rendering the waters barren in a few years; in others the reduction in the spawning areas has entailed a corresponding diminution in the productive capacity of the river, and caused important and remunerative fisheries to become comparatively valueless.

In the case of the salt-water predaceous species, the effect of obstructions in the rivers, whilst indirect, has been not the less potent in effecting a reduction of their numbers by diminishing their food supply.

In my annual reports to Congress I have had frequent occasion to revert to the disastrous effects of dams in our rivers in determining a reduction in the supply of our more important food fishes, and to urge the erection of fish-ways as a most important and indispensable adjunct to the restoration of our fisheries by artificial propagation, a work so wisely inaugurated and so beneficently sustained by liberal appropriations.

Usually the work of construction of fish-ways may appropriately be left to the States themselves, or to the coercion of State laws brought to bear upon the owners of dams. In those cases, however, where the General Government has created or maintains obstructions in our streams it seems eminently proper and in essential harmony with the work of artificial propagation, inaugurated and sustained by the Government, that suitable provision should be made to provide sufficient passage-way for fish over the obstructions.

My views in regard to the expediency and propriety of the General Government undertaking the work at the Great Falls have already been expressed in a letter to the Commissioners of the District, a copy of which is inclosed for the information of your honorable committee.

I can only add to the argument presented in that letter that the water supply requisite for the fish-way will be necessarily under the control of the District government, and must be subordinated to the necessities of the water supply of the District. This renders it necessary that the fishway, when built, should be operated subject to the entire control of the authorities of the District government.

I may state in conclusion that the opening of the upper waters of the Potomac and its tributaries to the ascent of fish cannot have other than a most beneficial effect upon the production of the river. That such a result may be attained there is no reason to doubt. The difficulties that may present themselves are mainly those of construction, and are entirely within the resources of the engineer to overcome.

I have the honor to be, very respectfully,

S. F. BAIRD,
Commissioner.

UNITED STATES COMMISSION OF FISH AND FISHERIES,
Washington, D. C., March 24, 1882.

DEAR SIR: I would respectfully suggest the propriety of including in any proposition for the completion of the dam at the Great Falls the construction of a suitable fish-way to admit the ascent of shad, salmon, striped bass, herring, sturgeon, etc., to the upper waters of the Potomac River. Prior to the building of the original dam, it was possible for many of these varieties of fish to reach their spawning grounds; but of late years this has been rendered impossible, and, consequently, the supply has most materially decreased. Many of the fish of the Potomac must have access to the upper waters of the river for the propagation of their kind, suitable spawning grounds not occurring below the dam.

Inasmuch as the injury above alluded to was brought about by an act

of the United States, it seems eminently proper that the same agency should remedy the difficulty, especially as the locality where such fish-way alone can be built is the property of the United States. The legislatures of Maryland, Virginia, and West Virginia are highly in favor of the improvement in question, and I see no impropriety in the granting of this proposition.

At the proper time I shall be happy to furnish a plan of construction upon the most feasible and efficient scale. The expense of this additional work will make but a small item in the total. It is important that for such construction some such proviso as that below should be added to the bill as it now stands.

Yours, very respectfully,

S. F. BAIRD,
Commissioner.

Maj. W. J. TWINING,
Engineer Commissioner, D. C.

Provided, That a suitable construction shall be built to admit of the upward passage, at all seasons of the year and at all stages of the water, of shad, salmon, herring, striped bass, sturgeon, etc., the same to be erected in accordance with the plans to be furnished by the United States Commission of Fish and Fisheries.

The committee accepted these recommendations, and reported to the House the original bill amended, so as to provide for suitable fish-ways at the Great Falls of the Potomac.

The bill, which became a law July 12, 1882, appropriated $50,000 for the construction of the fish-ways, and directed that the same should be erected according to plans and specifications to be furnished by the United States Commissioner of Fish and Fisheries.

Immediately after the appropriation became available, I detailed Col. M. McDonald, chief of the division of distribution in the United States Fish Commission, to take charge of the preparation of the plans and specifications, and to proceed at once to arrange for the necessary surveys. Colonel McDonald reported to Maj. G. E. Lydecker, Engineer Commissioner, in October, and was authorized by him to organize a field party and complete the necessary surveys, the expenses being certified to him for payment.

Mr. F. S. Eastman was designated as chief of the field party, and, in company with Colonel McDonald, made a reconnaissance of the ground. This developed four practicable sites for the erection of the fish-way. The one immediately at the Great Falls on the Maryland bank of the river was definitely determined on for reasons given by Colonel McDonald in his report.

The necessary minute survey of the site selected was deferred from time to time in consequence of the serious indisposition of Mr. Eastman; and the fatal termination of his illness making it necessary to secure the services of another engineer, Professor Hilgard, Superintendent of the United States Coast and Geodetic Survey, kindly detailed Mr. Eugene Ellicott, one of his staff of field assistants for the purpose. Unavoidable delays threw the field work into the most inclement season of winter, and necessitated the maintenance of the party in the field for a longer time,

and adding proportionately to the cost of survey. This work is now completed, and the map of the site proposed submitted. The preparation of the plans and specifications will proceed as rapidly as is consistent with the careful study of all the conditions involved, and an observance of the requirements necessary to insure ultimate success.

23.—DISTRIBUTION OF FISH AND EGGS.

The general principle of distribution of fish and eggs, referred to in the report of 1881, has continued during 1882, excepting that the transfer of fish in baggage cars of express trains, under charge of single messengers, has been much reduced in extent.

As long as the number of eggs and young fish was restricted, this was the most convenient and economical mode of performing the service. Now, however, with increasing supplies of shad, salmon, carp, etc., it is found that car-load shipments are much more economical.

These have been made partly on the transportation car of the Commission and partly in express cars engaged for the purpose. As the fish are always carried on passenger trains, it is, of course, understood that the cars must be suitable for such service.

An appropriation having been made by Congress for a second transportation car, the experience gained in fitting up No. 1 was made use of in the plan of No. 2. This plan was made by Mr. F. S. Eastman, who also superintended the construction. A contract was made with the Baltimore and Ohio Railroad Company for the work, and the car was delivered to the Commission, entirely finished, on September 13, 1882, the total cost amounting to $7,334.21.

Great difficulty has been experienced from the break of gauge on the Southern roads; all the Northern roads having a gauge of 4 feet 8½ inches, and the Southern system having adopted a 5-foot gauge. This made it necessary to secure a pair of trucks of the broad-gauge patterns, and to keep them at some point in the South, either at Wilmington, Danville, or other stations, where the change of the car from the one system to the other could be accomplished.

24.—SPECIES OF FISH CULTIVATED AND DISTRIBUTED IN 1882.

Within the last few years considerable changes in the names of the fishes most generally treated by the Fish Commission have resulted from the more extended research into the synonymy of the subject; these relating more particularly to the western *Salmonidæ;* and, in order to define with precision what the species are with which the Commission has to do, I first present the list, and then propose to take up each species separately and to give an account of the work bestowed upon it and the general results for the year. The complete synonymy will be found in an article by Dr. Bean in the appendix.

1. The sole (*Solea vulgaris*).
2. The turbot (*Rhombus maximus*).
3. The cod (*Gadus morrhua*).

4. The mackerel (*Scomber scombrus*).
5. The Spanish mackerel (*Scomberomorus maculatus*).
6. The striped bass (*Roccus lineatus*).
7. The white perch (*Roccus americanus*).
8. The black bass (*Micropterus dolomieu*).
9. The banded porgy (*Chætodipterus faber*).
10. The common whitefish (*Coregonus clupeiformis*).
11. The maræne (*Coregonus lavaretus*).
12. The brook trout (*Salvelinus fontinalis*).
13. The lake trout (*Salvelinus namaycush*).
14. The sälbling (*Salvelinus salvelinus*).
15. The rainbow trout (*Salmo irideus*).
16. The Atlantic or Penobscot salmon (*Salmo salar*).
17. The land-locked or Schoodic salmon (*Salmo salar* subsp. *sebago*).
18. The river trout (*Salmo fario*).
19. The Quinnat salmon (*Oncorhynchus chouicha*).
20. The shad (*Clupea sapidissima*).
21. The branch herring (*Clupea vernalis*).
22. The glut herring (*Clupea æstivalis*).
23. The sea herring (*Clupea harengus*).
24. The carp (*Cyprinus carpio*).
25. The gold-fish (*Carassius auratus*).
26. The golden ide (*Leuciscus idus*).
27 The tench (*Tinca vulgaris*).

a. **Whitefish** (*Coregonus clupeiformis*).

The Northville and Alpena stations.—Mr. Frank N. Clark, in charge of the Northville and Alpena (Mich.) stations, in the appendix to this volume, makes an interesting report of the labor carried on by him during 1882. The work performed in his department shows double the results obtained heretofore in a single year. The new station at Alpena was fitted up expressly for the hatching of whitefish, and about 32,000,000 of these fish were planted from that station in the Great Lakes. At the Northville station about 30,000,000 eggs of whitefish were received. Of this number 12,000,000 eggs were shipped to various points in the country, and 16,000,000 were hatched and deposited in the Great Lakes. There were handled at this station also 277,000 lake trout, 473,000 brook trout, 7,000 rainbow trout, 1,400 "German" trout, and 20,000 land-locked salmon; and 1,500 carp were distributed, in lots of 20, to applicants in the Northwestern States. The station has been increased in efficiency by the addition of two new ponds for breeding purposes. The Alpena hatchery, which has just been completed, is believed to be a model establishment. It contains, besides a hatching room, an office and dormitory and a storage room. The hatchery proper, which has a capacity for treating 100,000,000 eggs, is equipped especially for whitefish. The arrangements for supplying pure water and cutting it off at will

are especially satisfactory. The eggs of the whitefish were obtained this year in the usual manner; that is, from the ripe fish found in the nets of the fishermen. This plan is satisfactory only when all the concurring circumstances are favorable. Bad weather may interfere so as to destroy any possible chance of success. Mr. Clark now states that experiments have demonstrated the feasibility of holding the immature spawners in confinement until every egg has been secured, thus making it possible to save the entire crop of eggs not deposited by the fish themselves. The greater part of the eggs at the Detroit hatchery during the season were obtained in this way; and those eggs which were taken from fish brought from Lake Erie in casks, and held in tanks in the hatchery till they had matured, were found to be the very best procured at Northville. The improved condition of the eggs is due to the fact that by the new method much greater care is possible, and the hurry and confusion of pound-net operations is avoided. Mr. Clark hopes next year to follow this method to the exclusion of every other.

The eggs of the lake trout were obtained from the fish taken in gill-nets, and then shipped to Northville. The weather at the time was warm and many of the eggs arrived in Northville in poor condition. By the experience gained this year, and the improved facilities, it is hoped that a much better showing, both as to quantity and quality, will be made next season. The total number of lake-trout eggs taken was 277,000. Besides the usual number of transmissions to persons in the United States, a number of these eggs were sent to the Deutscher Fischerei-Verein of Germany and the Société d'Acclimatation of France. Mr. Clark also hatched out a number of trout eggs received from Germany. There were 5,000 in all, and they reached Northville on the 26th of March. The greater number of them were too far advanced to hatch out satisfactorily. A considerable portion, however, reached maturity, and are now doing very well indeed. They are quite as large as our own trout of the same age. Mr. Clark reports a failure with regard to the propagation of the rainbow trout—the first serious failure that the Northville establishment has made. Only 45,000 eggs of this species were obtained, of which but 15 per cent. could be fertilized. The number of fish hatched was 6,400. He is somewhat at a loss to discover what was the cause of the difficulty, but is inclined to attribute it to the abnormal character of the fluid surrounding the eggs. He suggests as another possible explanation that the parent fish were overfed, and that the inflow to their pond gave them a current too slow and feeble, the result being that they became too inactive. He proposes hereafter to try the experiment of reducing their food allowance to the minimum and placing them in a good current of water in one of the new ponds. Such treatment would seem to be in accordance with their natural habits. Twenty thousand eggs of land-locked salmon, from Grand Lake Stream, Maine, arrived at this station March 12, and were hatched out satisfactorily. The loss was trifling. They were distrib-

uted, when hatched, to lakes in Michigan. Mr. Clark remarks that land-locked salmon have done well in Michigan lakes, quite a number of adult specimens having been taken during the last year. The brook-trout work, too, was entirely satisfactory. Four hundred and seventy-three thousand eggs of this species were obtained, of which number 357,000 were shipped away, and 50,000 hatched. The whitefish fry were shipped from Northville by Fish Commission car, and from Alpena by car and boat. In this work the car was run over 7,000 miles. As a rule, the railroad companies made no charge for hauling the cars of the Commission. Two million fish were usually taken on a trip.

An interesting experiment is being made at the Northville hatchery in growing whitefish in confinement with the aid of artificial feeding. Mr. Clark placed in confinement 1,200 of the fry hatched March 12. On the 1st of September 276 were alive in good condition, and some of them were as much as six inches in length. This is the most successful experiment of the kind ever made, and opens up great possibilities in the future. Like young trout, they were fed exclusively on chopped liver. They grow very rapidly. Forty-seven million young whitefish were deposited in the following lakes: Lake Ontario, Lake Erie, Lake Huron, Lake Superior, and Lake Michigan.

Mr. Clark calls the attention of the Commission to the importance of making arrangements for penning up whitefish, so that the immature eggs may have a chance to ripen, and the whole work of removal and transportation be facilitated. He finds the whitefish particularly suited for this work, fully as much, if not more so, than the salmon or trout. He reports that Mr. Oren Chase, assistant superintendent of the Michigan State establishment at Detroit, was the first to adopt this method, finding it of the utmost possible benefit.

Mr. Douglass, at Sandusky, in behalf of the Fish Commission of Ohio, was successful in the same operation, taking several millions of eggs from penned fish.

The matter had not been brought to Mr. Clark's attention sufficiently early in the year to make the necessary arrangements for practical work, but his experiments in that direction were satisfactory, and he proposes in 1883 to carry out the process on a large scale, seeing no reason why the yield of eggs may not be brought up to hundreds of millions if necessary. It is to be understood, of course, that the treatment of the fish in this way does not injure it for market purposes.

For many years past, some of the establishments on the Detroit River have been in the habit of seining for the whitefish and placing them alive, when caught, in pools, thence to be taken out as the demands of the market might require. Considerable use was made of the opportunity of taking eggs from the ripe fish before they were put into the pool, but no artificial processes were subsequently applied to them. It is understood, however, that a great amount of natural spawning followed, with a very decided advantage to the fisheries of the river.

There has been a considerable amount of criticism on the part of State commissioners as to Mr. Clark's practice of hatching out white-fish "prematurely," as they call it, and, in their opinion, placing them in the lake when the water is too cold for them. A careful examination of the subject, however, does not substantiate the assertions, and the reasonings themselves are faulty. There is no reason to believe that the eggs are hatched out earlier in the Northville hatchery than they are spontaneously in the lakes, and the investigations by Mr. Forbes prove conclusively that, although the microscopic food for the young fish is not so much concentrated in cold weather as it is when warmer, there is yet an ample supply.

Among the special features of interest in the island of Mount Desert is a lake of deep, cold water of considerable extent, which is thought to be suitable for the growth of white fish.

At the request of Mr. Montgomery Sears, of Boston, who is a summer resident of Mount Desert Island, in the vicinity of this lake, I gave instructions to Mr. Frank N. Clark to set aside 1,000,000 eggs of the white fish in the Northville hatchery for the lake in question, and as there were no facilities at the lake for hatching out the eggs, I ordered the lot to be sent to the salmon station at Bucksport, there to be brought forward to a sufficient size for planting.

The eggs arrived at the Bucksport station on February 26, packed in one case, and were found to be in good condition. The temperature of the moss was below 35 degrees. A small percentage, however, hatched out and died; so that there was some smell about the package. The eggs were then carefully washed and put into water at a temperature of 33 degrees. A few hatched out within twenty-four hours.

Mr. Buck, the assistant to Mr. Atkins, who had charge of these eggs, thought it best to keep them at the hatchery, if possible, until the ice should be out of Eagle Lake, and the steamers running to Mount Desert. He therefore continued the use of the coldest water (below 34 degrees) until April 19. At that time about half of the eggs were hatched, and Mr. Buck took one twenty-gallon can filled with young fry to Mount Desert, for the purpose of making arrangements for the delivery of the entire number.

He found that the ice had thawed around the edges of the lake, and had no difficulty in finding a suitable place for introducing the fish.

The temperature of the water used in developing the eggs on April 26 had reached 37 degrees, by which time all the eggs were hatched out.

Mr. Buck on that day reached the lake at 9 o'clock p. m.; and in his opinion successfully planted 700,000 of the young fry.

The scarcity of suitable cans made it necessary also to use four casks which had received two coats of shellac on the inside. All the fish, however, transported in the casks died on the way.

Mr. Buck states that the fry taken down on the 19th were liberated upon the north side of the lake, about one-fourth of a mile westward

from the outlet. Those liberated on the 26th were taken up the eastern shore in boats as far as the ice permitted, and scattered along shore as much as practicable; most of them from one-half to three-fourths of a mile from the outlet, all upon rocky bottom.

The results of this experiment will be looked for with much interest; and by 1885 the increase, if any, should be appreciable.

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

The Bucksport (Me.) Station.—The report of Mr. Charles G. Atkins, the assistant in charge of the Maine hatching stations, shows a very satisfactory condition of affairs there. As usual the United States Commission carried on this work in connection with the fish commissions of Maine, Connecticut, New Hampshire, and Massachusetts. The first Penobscot salmon eggs were taken October 28. The total number of eggs taken was 2,090,000. These were obtained from 250 females, showing an average of 8,360 eggs per fish. Ninety-eight per cent. of these eggs were successfully impregnated, and 95.7 per cent. were shipped; in round numbers 2,000,000. The share of these belonging to the United States was 1,208,000. The mortality among the spawners kept in the inclosure was considerably less than in 1881. This is attributed to the smaller size of the Penobscot variety this year. Penobscot salmon eggs are now shipped in the same way that they have been for years at the Maine stations, except that layers of chopped hay are used instead of moss. Moss is difficult to obtain, and hay is found to be a very satisfactory substitute. In all cases, however, wet bog moss is still the material in which the eggs are first embedded.

All the packages reached their destination in safety, and the hatching was so successful that 1,716,617 healthy young salmon were turned out in public waters.

Mr. Atkins furnishes an interesting chapter in regard to marked salmon. In the autumn of 1880, 103 females and 81 male salmon were marked with the usual platinum tags. The fish were, at the close of the spawning season, let loose. In the spring of 1881, 12 were recovered. This number was less than had been hoped for, though it was probably as large as could be expected.

The data obtained in this way affords a substantial corroboration of the conclusions drawn from previous experience. Four females, in two years, increased 40 per cent. in weight and 14 per cent. in length. These experiments, in Mr. Atkins's opinion, warrant us in saying that salmon visit the Penobscot River for the purpose of spawning but once in two years, and that they visit it for no other purpose.

The number of fish purchased and held by Mr. Atkins for spawning purposes was 470; of eggs, as stated above, 2,000,000 were secured.

The Roslyn (N. Y.) Station.—Desirous of hatching salmon eggs intended for New York waters in some central station from which the young fry could more readily be distributed, I placed the matter in the

hands of Mr. Fred. Mather, and Mr. E. G. Blackford, fish commissioner of New York.

Mr. Thomas Clapham kindly offered the use of his establishment at Roslyn, on the north shore of Long Island, in Queens County, New York, a station on the Locust Valley or Glen Cove branch of the Long Island Railroad, distant 23 miles from New York, where trout ponds had been constructed some years before, together with a building intended as a hatchery.

The only special work necessary for this station was the construction of troughs. Unfortunately, the eggs were received before the troughs were properly tarred and dried, and the success was not as great as would otherwise have been the case.

With 344,500 eggs received, 170,000 fish were planted in tributaries of the Hudson River; 45,000 in Salmon River, a tributary of Lake Ontario, and 10,000 escaped in Clapham's Stream.

The salmon hatching of the ensuing autumn and winter was prosecuted at Cold Spring Harbor, on Long Island, a new station of the New York State fish commission.

c. **Schoodic or Land-locked Salmon** (*Salmo salar* subs. *sebago*).

Grand Lake Stream Station.—Extensive improvements have been made at Grand Lake Stream Station, on the Schoodic Lakes, in the way of new buildings for hatching and other purposes. It is thought that with the increased accommodations any procurable stock of eggs can be well cared for. The Schoodic salmon work commenced about the middle of September and ended November 4. The total number of male fish obtained was 600; females, 1,004; constituting the finest fish as to size and condition ever taken at that station. The males averaged 3.1 pounds in weight; the females, before spawning, 3.2 pounds. Measurements show that the average length of both sexes was eight-tenths of an inch more than in 1880, and the fish this year were also heavier. The number of defective eggs yielded by the fish was smaller than ever before. It was found that about 91 per cent. of the eggs were successfully impregnated—about the ordinary rate. Nine hundred and forty-five out of the 1,014 females taken yielded spawn which weighed 727 pounds, and the number of eggs was 1,681,000. The yield of eggs per female fish averaged 1,779, the highest average yet recorded at the station.

The total number of eggs of the Schoodic salmon for distribution, after deducting all losses, was 1,428,330 eggs. Of this number 374,330 were reserved for Grand Lake, and the remainder, 1,108,000, shipped to the several subscribing commissions. The share of the United States Commission was 478,000 eggs. The transportation of the eggs, which was performed in the usual manner, was entirely successful in results. The fish as a rule were hatched out successfully, and were placed in rivers and ponds in the Eastern, Middle, Western, and one or two Southern States.

The Roslyn (N. Y.) Station.—Reference has already been made to this station in charge of Mr. Fred. Mather, under the head of "Atlantic Salmon." It was also used for bringing forward a number of eggs of land-locked salmon, hatched out for distribution in New York.

From 10,000 eggs received on February 18, 1882, 5,000 fish were planted in Skaneateles Lake on May 2, and 5,000 placed in the waters of the South Side Club of Long Island.

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

The Northville Station.—Not much was done during 1882, in connection with this species, by the United States Fish Commission. A few hundreds of thousands of their eggs were taken by Mr. Clark of the Northville Station, and developed for distribution, as indicated in the general table.

The largest amount of this work appears to have been done by the New York State commission.

The lake trout is not considered a very palatable variety, and there is consequently very little demand for it. Whenever it is called for, to stock waters unsupplied with this fish, the eggs can be readily obtained and supplied.

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

The McCloud River Station.—Mr. Livingston Stone, in charge of the salmon-breeding station on the McCloud River, began active work September 3, and it was continued till September 25, at which time he had over 4,000,000 eggs in the hatching house. Mr. Stone had been instructed to take only about this number and then to give them to the California Fish Commission to be hatched out and placed in the Sacramento. This action of the United States was thoroughly appreciated by the California Commission. One of the commissioners stated officially that the annual salmon catch of 5,000,000 pounds depended entirely on the work of the United States Commission. Although breeding fish at this station this year were scarce, their weight exceeded that of the breeders of any previous season. The average weight of the females after spawning was about 14 pounds. One fish before spawning had the enormous weight of 27 pounds. Mr. Stone, is his report, bears cheerful testimony to the help of the Indians in the vicinity of the station. Their services were almost invaluable to him in the prosecution of his work.

Mr. Stone made some interesting experiments in impregnating eggs of the salmon. He allowed the eggs to remain in the pan for periods of different lengths before the milt was put on, the eggs being taken in a dry vessel and no water used until after impregnation. The result of these experiments indicates that when the milt is eighteen hours old it is impotent; second, that impregnation does not occur if the eggs are washed immediately after milt is added; third, that there is a slight chance of impregnating successfully eggs taken from dead fish; fourth,

that milt is more efficacious the sooner it is applied to the eggs. The Canada process was found to be a very successful method of impregnation. In this process the eggs of one fish at a time are taken in a dry pan, and as soon as impregnated each pan of eggs is poured into a bucket of water. Another process was to take the eggs and milt together in a dry bucket as rapidly as possible. This method was found to be inferior to the Canada process.

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

Although the work of the Fish Commission has been mainly limited to the anadromous species, such as the salmon, shad, fresh-water herring, &c., it was found expedient to bestow some attention to the more local forms, especially the California mountain trout, which, it is thought, will answer an excellent purpose in supplying streams which formerly abounded in the Eastern brook trout, but which, by reason of the clearing of the land, with the consequent reduction in the volume and the change in the other characteristics of the water, no longer answer that purpose.

The selection of the California trout is based on the fact that they are known to exist comfortably in waters several degrees warmer than the temperature suited to our common brook trout.

The McCloud River Station.—Mr. Stone's report on the trout-breeding station on the McCloud River shows that 337,500 eggs of trout were distributed to various parts of the United States.

The taking of eggs extended from the 5th of January to the 5th of May. The spawning season on the whole was quite successful. Great care is necessary in transporting these eggs, as, besides, the 3,000 miles of journey by rail, they must be carried a considerable distance on horseback and by stage. Reports from the consignees of these eggs (principally fish commissioners of the different States) say that the eggs arrived in excellent condition, the proportion of bad eggs being very small. Mr. Stone lost very few fish by death. Even during the spawning season very few died. The trout recuperate very rapidly after spawning. The ponds now contain about 2,000 trout, which weigh from 2 to 10 pounds apiece. Mr. Stone concludes, after a thorough examination of the subject, that there is only one variety of black-spotted trout in the United States ponds on the McCloud River, or that if there are two varieties they shade into each other by imperceptible degrees.

The various scattering lots of trout eggs ripening in too small quantity to be worth shipping to the East were presented to the California State Fish Commission. These were more than made up by a number obtained from the Lenni Fish Propagating Company in exchange for eggs of the California salmon.

The Northville (Mich.) Station.—A number of years ago Mr. Clarke, in charge of this station, established primarily for the hatching of the whitefish, when on a visit to the salmon and trout ponds of the

United States Fish Commission on the McCloud River, brought back a number of these fish, and took proper care of them until they became mature. He then made the necessary arrangement to take their eggs, and for several years this station, next to that on the McCloud, has furnished the principal supply. A considerable portion of the California stock of eggs is sent to Northville and hatched out for distribution, enough being retained to maintain the breed. In 1882, 45,000 eggs were received February 2, and 40,000 February 20. Of this last lot only 393 were found to be dead.

The eggs obtained from the Northville establishment entered into the general distribution made by the Commission.

The Wytheville (Va.) Station.—The better to hatch out eggs of the mountain trout to supply the Southern Alleghanies with this desirable species it was found to be necessary to establish a station specially for the purpose of this enterprise; one, of course, where an ample supply of cold spring water could be readily obtained, and yet not too remote from the city of Washington to be under constant supervision. This station was found at Wytheville, Va., where several years ago the State Commission had established, and successfully worked, a station for the propagation of trout.

Satisfactory arrangements were made with the Virginia State Commission, through Colonel McDonald, to rent the station in question, at the expense of the United States Fish Commission, and maintain it in the interests of the same.

In order to make the necessary improvements to carry out the work on the scale contemplated, the services of Mr. C. E. Junkin, of the Coast Survey, were secured in 1881 for the purpose of making a topographical map of the station.

The actual work of the Commission at the station was inaugurated in February, 1882, when 25,000 eggs of the *Salmo irideus* were received from the ponds at Baird, Cal. They were taken charge of by Mr. E. H. Walke, who has for several years been associated with the United States Fish Commission and the North Carolina State Fish Commission, in the hatching of shad; and the station remained under his direction until Mr. Seagle, its regular keeper, had acquired sufficient familiarity with the treatment of the trout to be able to care for them himself.

Twelve thousand five hundred healthy fry were obtained from this crop of eggs, a portion of which will be held for distribution to adjacent localities when of sufficient size and the remainder kept for breeders.

By planting young fish in streams in the immediate vicinity, and gradually extending the range, it is hoped that, in due time, the whole of the Southern Alleghany region can be supplied, and an extension secured over a vast area of country. It is proposed to enlarge the station by the construction of new ponds, which will, of course, admit of carrying on the work on a much greater scale.

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

Northville Station.—In view of the fact that the brook trout has constituted one of the principal objects of consideration by the Fish Commissioners and fish culturists in the Northern States, it has not, as explained in previous reports, received much attention from the United States Fish Commission. A small supply of breeders is, however, maintained by Mr. Clarke at the Northville (Mich.) hatchery, and the product has been distributed to a few special localities—for the most part sent to Europe, in exchange for other species. The disposition in question will be found recorded in the table of distribution in Mr. Clarke's report. There were 473,000 eggs obtained, 357,000 eggs shipped, and 50,000 fry hatched. Those shipped to Europe invariably arrived in good condition.

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

Quantico Station.—Three stations for the propagation of shad were operated on the Potomac River during the season of 1882.

The Fish Hawk, under command of Captain Tanner, was stationed at Quantico and collected eggs from that section of the river lying south of Indian Head. In addition to the work of shad propagation, many millions of eggs of the river herring were hatched and planted in local waters. Of the product 2,000,000 fry were sent by car No. 2, and planted in the Colorado River, at Austin, Tex., the experiment being made with the expectation that this species could be acclimated in these waters, and from its wonderful fecundity become an important addition to the resources of the river. Should these anticipations be realized, it is proposed to plant this species largely in all the tributaries of the Gulf of Mexico.

In this connection it may be mentioned that the first Potomac shad of the season was said to have been taken on the 21st of February; this was at White Point, Va., nearly seventy miles below Washington.

A summary of the work done is as follows:

	Number.
Eggs taken and impregnated	2,407,000
Shad furnished for distribution	800,000
Herring furnished for distribution	2,000,000
Shad deposited in local waters	1,755,000
Herring deposited in local waters	7,883,000

For fuller details in regard to the work of the station, reference is made to the report of Captain Tanner.

Navy-yard Station.—This station was in charge of Lieut. W. M. Wood, commanding the Lookout, Master W. C. Babcock and Master A. C. Baker being in immediate charge of the hatchery. Eggs for the supply of this station were collected from Moxley's Point and the gillers in that section of the river around Fort Washington; the Lookout being employed to collect and transfer the eggs to the station. During the season 21,820,000 shad eggs were collected, which yielded 17,935,000 fry. Of these 3,050,000 were deposited in local waters, 14,444,000 turned

over to Central Station for distribution, and 441,000 sent directly to deposit in the Potomac at Little Falls.

Central Station.—To this station was allotted that section of the river extending from Chapman's to Ferry Landing. The methods adopted for the collection of the eggs, as well as the apparatus in use for hatching at the station during this season, are novel, and mark a substantial advance toward that concentration of work and economy in production which is necessary in order that the results obtained may compensate for the expenditures made in artificial propagation. What is now known as the dry method of transportation was employed in the collection and transfer of the eggs to Washington. Instead of being sent in vessels of water by messenger, after being impregnated they are transferred to shallow trays covered with damp cloth, and forwarded by the ordinary channels of communication on the river, reaching the station at periods from six to thirty-six hours after impregnation. On arrival at the station they are immediately transferred to the automatic hatching jars, by which the separation of the dead eggs is completely effected without the use of scalp nets or other appliances for the purpose, involving mechanical labor and constant attention.

The methods of transportation employed and the apparatus for hatching in use at the station during the season have given complete satisfaction. The number of eggs received at the station during the season was 6,706,000. The number of fry hatched out, 5,393,000.

The distribution of shad to new waters was made largely through Central Station, the total number of fry distributed during the season being 20,637,000. This total includes the plants made in the Potomac River, but does not include those made in the Susquehanna River from the Havre de Grace Station.

Of this total 800,000 were drawn from the Havre de Grace Station on the Susquehanna, and 19,837,000 from the Potomac River stations; the Navy Yard Station contributing 14,444,000, and Central Station 5,393,000.

The most notable feature of this distribution was the planting of large numbers of fish in single localities, instead of distributing, as heretofore, in smaller lots to a number of localities in the same stream. The extreme distance of the distribution was the Colorado River in Texas, and the Smoky and Republican Rivers in Kansas. The total distance travelled by the cars in this distribution was 12,192 miles; 9,730 miles being made by car No. 1, and 2,462 by car No. 2. The total number of shad fry produced during the season of 1882 at all the stations, and including those deposited directly in the Potomac and Susquehanna rivers was 30,283,000.

Battery Station.—In 1879 the shad and herring eggs collected from the fish taken on the Chesapeake flats and procured from the large seines hauled in the neighborhood of Havre de Grace, Md., were hatched

on floating barges, anchored in Spesutie Narrows, a narrow channel separating Spesutie Island from the mainland.

To enable the steam launches used in this work to ply between the fisheries and this central hatching station at all stages of the tide, it was necessary that a channel should be dredged across the bar which had formed at the northern mouth of the narrows. By special instructions from the President, or Secretary of War, Colonel Craighill, in charge of the engineer work of the district embracing the Chesapeake Bay, had a channel dredged which greatly facilitated the work during the season.

Having secured for a term of years the fishing advantages of Battery Island (which is situated in the center of the bay, about 3½ miles directly south from Havre de Grace), as being a location much more central to the fisheries from which we received the spawn, Colonel Craighill was advised of our plans, and in compliance with a resolution of the Senate, made a survey of the surroundings and an estimate of the cost of deepening the channel and constructing the piers and a breakwater necessary for the conduct of our work; but it was not until the following year (1880) that an appropriation was made. The work was commenced in July of that year.

A channel was dredged to the island, securing a draft of 7 feet, and a pool of the same depth, formed by crib-work filled with earth and stone, was formed for the protection of the hatching barges and small boats of the Commission, and also for the storing of the live fish which might be taken before the eggs were thoroughly developed in the ovaries. In this pool the "unripe" fish will be retained, and the eggs taken from time to time as they mature. The material dredged from the channel and the pool was thrown behind the crib-work and raised considerably the level of the remaining portion of the island.

Additional appropriations for strengthening and extending the piers were provided for in the bills for river and harbor improvement in the following years (1881 and 1882), sufficient, it is hoped, for the completion of these improvements, and the work has thus far been prosecuted in a most satisfactory manner.

As the fishery on this island was one of the most successful and remunerative of the large fisheries of the Upper Chesapeake, it is confidently anticipated that we will have ample material in the way of parent fish, and that the production of young shad will be greatly increased and the operations carried on much more compactly than heretofore.

In the spring of 1881 two small cottages, one of five rooms and the other containing two rooms, and an ice-house, constructed on the Ridgway principle, were erected at the station, and the cottages occupied as quarters for the corps during the fishing season.

It was not, however, practicable until the spring of the present year (1882), to erect a suitable hatching house, the hatching operations hav-

ing been conducted during the previous year on the hatching barges, as heretofore, with the exception that they were moored in the pool above referred to instead of occupying the location in Spesutie Narrows.

During the present year a spacious two-story hatching house, about 20 by 60 feet, has been erected. A section of 20 feet of this contains the engine, boiler, and water-tank. The remainder of the first floor of the building is devoted to the hatching apparatus, and as its capacity is many millions of eggs it is hardly probable that the floating apparatus will be needed at this station hereafter.

The second story of this building furnishes comfortable accommodations for from sixteen to twenty men, and has been provided with steam heating apparatus, the steam being furnished from the same boiler which does the pumping and seine hauling.

During the summer and fall considerable work has been done toward the construction of an apron for landing the seine. This important work, however, had to be intermitted on account of the ice, but sufficient has been done to insure its completion in the early spring—in time to be available for the fishing during the coming season.

The northern pier has been considerably extended and strengthened during the present year by the force under the direction of Colonel Craighill. This work is important as this pier, as extended, forms, with that already constructed, an outer harbor protected from the ice as well as from the westerly and northerly winds, while the island makes a lee from all easterly winds and the original or southern pier gives thorough protection from those from the south, making a safe mooring for the small boats of the Commission outside of the pool. The pool can hereafter be devoted exclusively to the reception and care of the fish taken in the seine.

North East River (Md.,) Station.—After the shad work in the Potomac was over the Fish Hawk was moved to Havre de Grace and continued its work in hatching shad. The first eggs were taken May 23 and the work continued until June 12, a total of 2,551,000 eggs having been secured from 191 shad. There were hatched 1,765,000 fish, of which 1,555,000 were returned to the North East River and 210,000 furnished for shipment. About 25,000 eggs which remained on hand June 12 were turned over to Battery Station.

In previous reports accounts have been given of the work prosecuted by the United States Fish Commission at Avoca, N. C., the fishing station of Doctor Capehart, near the mouth of the Chowan River. This station was not occupied during the season of 1882, but the work there was prosecuted by the North Carolina Commission, under the direction of Mr. S. G. Worth. The total number of fish hatched was 2,260,000, which were planted in the principal rivers of the State.

The following statement of distribution of shad from 1872 to 1881 may be of interest:

Released where hatched	93,041,450
Hatched and planted elsewhere	71,334,300
Lost in transit or experiments	4,515,100
Sent part way to Germany	500,000
Total to 1882	169,390,850

The accompanying table gives a summary of the distribution of shad by States. Add the aggregate of this (28,716,000) to the preceding table, and we have as the total of distribution for the years up to and including 1882, nearly 200,000,000 to date.

Distribution of shad from April 26, 1882, to June 17, 1882, by the United States Fish Commission.

States.	No. of lots.	Streams stocked.	Number of fish.
Alabama	3	Alabama, Conecuh, Escambia	850,000
Arkansas	2	Black, Washita	432,000
Delaware	1	Nanticoke	891,000
District of Columbia	1	Eastern Branch	8,050,000
Georgia	10	Chattahoochee, Oconee, Yellow, Coosa, Etowah, Oostanala, Withlacooche, Flint.	2,831,000
Illinois	1	Kaskaskia	145,000
Indiana	1	Wabash	145,000
Iowa	1	Mississippi	958,000
Kansas	5	Smoky Hill, Saline, Solomon, Republican, Big Blue	222,000
Kentucky	5	Kentucky, Cumberland, Salt, Green, Barren	1,000,000
Maine	2	Sebastacoock, Mattawamkeag	475,000
Maryland	10	Potomac, Susquehanna, North East	7,769,000
New York	3	East, Hudson	983,000
Ohio	4	Sandusky, Muskingum, Scioto, Hockhocking	1,595,000
South Carolina	2	Broad	497,000
Tennessee	1	Tennessee	400,000
Texas	3	Colorado, Big Cypress, Trinity	1,518,000
Virginia	18	Quantico, Rappahannock, Appomattox, Shenandoah, Rivanna.	3,605,000
West Virginia	2	Ohio, Potomac	450,000
Total	84		28,716,000

i. **The Potomac Herring** (*Clupea vernalis*).

Quantico Station.—A large number of herring as well as of shad eggs were taken by the Fish Hawk while anchored at Quantico. The opportunity was utilized to make some experiments in hatching these eggs. Between April 12 and May 9 there were taken 677 ripe male herring and 644 females. These furnished 66,206,000 embryonized eggs. Although most of these were killed by the cold water, 7,883,000 were successfully hatched and for the most part returned to the river. Two millions were, however, deposited in the Colorado River, at Austin, Tex., on the 2d of May, in hopes of establishing the species in the Gulf of Mexico.

Record of herring-hatching operations conducted by the United States Fish Commission steamer Fish Hawk, Lieut. Z. L. Tanner, United States Navy, commanding, at Quantico Creek, from April 12 to May 9, 1882.

Date.	Herring taken.		Eggs obtained.	Eggs lost.	Returned to local waters.	Used for experiments and sent to armory.
	Males.	Females.				
1882.						
April 12	3	2	40,000	500	.....	.....
12	3	3	100,000	500	.....	.....
13	3	4	250,000	1,500	.....	.....
13	2	3	50,000	4,500	.....	.....
14	29	24	2,200,000	2,200,000	.....	.....
15	24	22	1,330,000	1,330,000	.....	.....
16	7	6	600,000	600,000	.....	.....
17	52	55	6,800,000	6,800,000	.....	.....
18	7	8	1,400,000	1,400,000	.....	.....
18	12	10	1,000,000	.....	.....	1,000,000
19	5	5	2,100,000	.....	.....	2,100,000
20	2	2	450,000	450,000	433,000	.....
21	29	27	3,400,000	3,400,000	.....	.....
23	15	15	1,600,000	1,600,000	.....	.....
24	23	19	3,350,000	3,350,000	.....	.....
25	63	64	6,600,000	6,600,000	.....	.....
26	46	47	4,500,000	1,800,000	.....	.....
27	48	45	3,600,000	2,300,000	.....	.....
28	93	82	7,780,000	7,780,000	.....	.....
29	25	23	2,250,000	1,650,000	.....	.....
30	15	15	1,200,000	1,200,000	.....	.....
30	15	15	1,300,000	350,000	.....	.....
May 1	61	57	5,796,000	3,896,000	.....	.....
3	31	33	2,900,000	900,000	1,300,000	.....
4	6	4	500,000	500,000	.....	.....
5	3	4	360,000	360,000	1,450,000	.....
6	.....	.....	.....	.....	2,000,000	.....
7	14	15	1,400,000	1,400,000	2,700,000	.....
8	29	25	2,350,000	2,350,000	.....	.....
9	12	10	1,000,000	1,000,000	.....	2,000,000
	677	644	66,206,000	53,223,000	7,883,000	5,100,000

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

The Washington Stations.—The service of the United States carp ponds has been faithfully superintended during the year by Mr. R. Hessel, under whose charge they were originally laid out, and who has had direction of them ever since. In addition to rendering this station a serviceable one, considerable attention has been paid to landscape effects by the proper arrangement of islands and ponds, and also by the introduction of plants, which, while having a beneficial relationship to the fish, add to the attractions of the place. The ponds are all very beautiful in their general effect, and in time will doubtless be pre-eminent in this regard.

The water-lily group, especially those belonging to the genera *Nymphæa* and *Nelumbium*, have been particularly cultivated, so that there is quite a large number of rare species represented.

The advice of Mr. J. F. Olmstead, the landscape engineer, was obtained in regard to certain ponds which could be used by skaters. For the purpose of aiding in the means of amusement to the citizens of Washington, one of the reserve ponds is usually prepared for the use of skaters by removing the fish and keeping the water up to the proper level. Some years there is not ice enough to allow this amusement,

but the surface of the pond was sufficiently covered to allow skating on the 3d of January, and for some considerable time subsequently.

The ponds were a second time frozen over on the 9th of December and became again the resort of a large number of people.

As a return for favors extended to the Deutsche Fischerei-Verein, Herr von Behr forwarded a number of blue carp, a variety believed to be of particular interest, and which has not been heretofore cultivated by the Commission. These arrived on January 4, and on examination of them by Mr. Hessel nineteen were found to be pure blood, and were placed in the ponds. Four hybrids were destroyed.

It may be stated in this connection that for several years a night heron and a bald eagle have been kept alive in cages and fed with refuse and hybrid fish, thus adding to the interest of the station. These same fish were also fed to the terrapin and turtles, kept in their special ponds.

The drawing of the ponds for the purpose of removing the carp is always an occasion of much interest, large numbers of persons usually resorting to the ponds to witness it. At the drawing on the 1st of April the President and many members of Congress were present.

Distribution of carp.—In this distribution it was necessary to provide for the supply of nearly 10,000 applicants, located in all sections of the United States. To make it by messenger shipments, as in previous years, would have involved an expense considerably exceeding the entire amount appropriated for the propagation and distribution of this fish. It was determined, therefore, as far as practicable, to make the distribution by means of car and express shipments. For this purpose centers of distribution convenient to one or more States were established, to which the fish were sent in bulk, and thence distributed to applicants by express.

The cost of the movement of the fish from Washington to the centers of distribution thus established was paid by the United States Fish Commission, the small express charges thence to destination being paid by applicant. This method was adopted in order to place all applicants, however distant they might be from Washington, upon the same footing so far as expense was concerned.

In anticipation of the opening of the season a new car with refrigerating compartments had been constructed according to plans furnished by Mr. Frank S. Eastman, engineer officer of the Commission. The old car was also remodeled in its interior arrangements so as to conform essentially in construction to the new car.

The season opened with a car shipment to Boston, in which arrangements were made for the supply of all applicants in the New England States, New York, and Northern New Jersey. From this time to the close of the season the cars were in continual movement, the theater of distribution being transferred further and further to the south as the winter advanced, the last movement of car No. 1 being to San Fran-

cisco, Cal., with carp for the supply of Texas, Arizona, New Mexico, California, Nevada, Oregon, and Washington Territory.

The following summary of distribution will be of interest:

Carp were sent into two hundred and ninety-eight of the three hundred and one* Congressional districts, and into 1,478 counties. There were 260,000 carp distributed, in lots of 20, to 9,872 applicants, residing at an average distance of 916 miles from Washington, the extreme points supplied being Southern California, Oregon, and Washington Territory, which were reached by special messenger from San Francisco. The total mileage traversed, counting all as single shipments from Washington to destination, was 9,045,000 miles. The distance traversed by the cars in making this distribution was 34,502 miles, of which car No. 1 traveled 20,601 and car No. 2, 13,901 miles. Details of this work will be found in the report of Col. M. McDonald, chief of division of distribution.

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

The Fulton Market (*New York*) *Station.*—The experiment of hatching cod at Wood's Holl, Mass., having been seriously interfered with by the extreme cold of the winter of 1881, it was deemed advisable to make Fulton Market, New York, an experimental station. To this point considerable numbers of cod are brought alive by the fishing smacks, which capture them in the neighborhood of Block Island.

Mr. E. G. Blackford, one of the commissioners of fisheries of the State of New York, and a large fish dealer of Fulton Market, having every opportunity of observing the condition of the fish arriving at this market, and informing himself of the occurrence of spawning fish, was requested to notify us when ripe fish appeared, and arrangements were made to send on expert fish culturists for the purpose of establishing an experimental station.

As this was impracticable of accomplishment in the immediate vicinity, on account of the foulness, and its lack of proper salinity, in the water around the docks of New York, it was necessary to collect the eggs at Fulton Market and transfer them to some other point. It was therefore decided to try first the experiment of bringing the eggs to Washington, and using sea water brought from Chesapeake Bay, and also artificially prepared water from the sea salt, in their development at the Central Station; second, if this did not prove feasible, another experiment was deemed worthy of test, viz, after collecting the eggs in New York, to transfer them to the hatching steamer Fish Hawk, which would be stationed for the purpose in the lower part of Chesapeake Bay, where the dangers from encountering ice would be comparatively small.

If either of these experiments should result favorably, the multiplica-

* Those not supplied were the second district of Rhode Island and the sixth and seventh of New Jersey, from which no applications were entered.

tion of cod and their transfer to limits further south than their present habitats, could be done at comparatively small cost, and to an almost unlimited extent.

Preliminary arrangements were also made looking to the transfer of the live parent cod direct from the fishing banks where they were taken, to the mouth of the Chesapeake Bay near Norfolk, where they could be kept in cars until the eggs became mature in the ovaries. This had been attempted the previous season at Wood's Holl, but the forming of "anchor" ice in the Little Harbor (which is fatal to the fish) had interrupted the work. This last experiment was postponed, as it was attended with considerably more cost than the hatching operations contemplated in Washington and on the Fish Hawk.

On the 14th of February, among the cod captured in the neighborhood of Block Island, were found several with the ovaries sufficiently mature and about four millions of eggs were taken on that date, but a comparatively small number of these proved to be properly impregnated, as ripe male fish were exceedingly scarce.

The first lot of eggs, received February 16, at Central Station, was a total loss. This was attributed to the apparatus in which they were transmitted from New York. Several lots in hermetically sealed vessels at a very low degree of temperature arrived in a very much better condition. The development was carried forward eleven days, at which time the fish were plainly visible in the eggs. Although lost at this stage it was considered quite encouraging that eggs which had been transported so far and subjected to such varying conditions attained this degree of maturity.

About this time Prof. John A. Ryder was sent to New York to watch the development of the eggs, with instructions to reserve samples from the different lots for development on the spot, and ascertain, if possible, the cause of the mortality, and to learn with accuracy the stage at which the eggs died.

On the 25th of February the Fish Hawk was ordered to proceed from Washington to the mouth of the Potomac River, with instructions to examine certain oyster beds of Chesapeake Bay in that neighborhood, and set her nets in order to ascertain whether there was any movement of fish in the bay. Her tanks having been supplied with salt water, advantage was taken of this opportunity for testing the second experiment. She sailed on the above-mentioned date with a large number of cod eggs immediately after their arrival from New York. These died within twenty-four hours of their transfer to the hatching apparatus. The full details of this experiment will be found in the extract given below from Captain Tanner's report.*

* On the 25th of February there were received on board 1,000,000 cod eggs from the United States Fish Commission, which were placed in spawning pans with artificial sea water for transportation to Chesapeake Bay, when they were to be placed in the

By this time the season had so far advanced that there was little prospect of obtaining material for further experiment, so the force was recalled from New York, and the cod work discontinued for the season.

The experiments made by the Commission clearly show that special preparations must be made for collecting and keeping the parent codfish for a considerable time and in suitable water. It is hoped and believed that the arrangement proposed for the Wood's Holl Station will answer every purpose, and that in a few years the work will be a complete success.

Much interest has been excited both in Europe and America by the experiment of the Commission with codfish, and the commissioners of several foreign governments have asked permission to witness them. A similar favor was asked by Mr. Harvey, of Saint John, Newfoundland. At the proper time it will, of course, be a pleasure to welcome any one to the station desirous of seeing it operated.

m. **The Striped Bass** (*Roccus lineatus*).

It was not possible to accomplish anything during the year in reference to the artificial propagation of the striped bass, no localities presenting themselves of sufficient promise to warrant the establishment of hatching stations. The success, however, of the experiment made a few years ago of the transportation by Mr. Livingston Stone, of the United States Fish Commission, of striped bass to California, has induced the commissioners of that State to renew their efforts, and Mr. Woodbury was sent East to obtain a fresh supply of the young fry.

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cones for hatching, using water from the bay. About 75 per cent. of the eggs appeared to be alive when they were brought on board.

At 12.50 p. m. on the date above mentioned, we left the navy-yard and steamed down the Potomac River; at 10.45 p. m. anchored in Cornfield Harbor.

The cod eggs were distributed among three cones and one glass aquarium, the water of the bay and river being used; they sank to the bottom, showing that the specific gravity was much less than that of sea water. They were then treated as shad eggs, the feed water being admitted at the base, and discharged through the gauge at the top of the cone in the usual manner. The aquarium was covered with one thickness of white bunting, which prevented oscillation by the motion of the vessel, and allowed the water to escape freely. A quarter-inch glass tube was introduced as a feed-pipe, and the discharge took place through the bunting cover. The temperature of the water was 40° F. at the surface, and 41° F. in the cones.

On the 26th, about 60 per cent. of the eggs seemed to be alive, although little or no development had taken place since the day before. They sank promptly, and the ordinary water feed for shad hatching would not keep them at the surface.

When the eggs were received on board they were 0.06 of an inch in diameter, germinal disk, $\frac{1}{125}$ of an inch, the live eggs seeming to be healthy. During this day, the germinal disk appeared to have contracted, and the proportion of dead eggs rapidly increased.

On the morning of the 27th, there were but few cod eggs alive, and they were in an abnormal condition, the germinal disk distorted, shrunk, and shriveled.

At 9.10 p. m. no good cod eggs were to be found in the cones.

On the 1st of March all the dead cod eggs were thrown overboard and the tank, cones, &c., cleaned and properly cared for.

Guided by information from Mr. Blackford, Mr. Woodbury obtained, at Red Bank, N. J., on July 18, yearlings from 4 to 5 inches in length. No fish of the year's spawning were obtained. Several hundreds of these were successfully transported to California and placed in waters there by Mr. Woodbury.

n. **The Black Bass** (*Micropterus*).

In accordance with the policy of the Fish Commission, no special efforts have been made looking toward the introduction of the black bass into new waters of the United States. All that has been done in this respect has been performed either by State commissioners or by individuals. Without pretending to decide as to the expediency of such introduction, the United States Fish Commission has surrendered this department, as stated. Its intervention, however, has been invoked by various parties abroad, and on the 2d of July arrangements were made to supply Count von Dem Borne, of Germany, with a quantity of these fish. On September 30, Mr. William T. Silk reached New York to obtain bass for Lord Exeter, of England, from whom he brought letters. Mr. Silk was placed in communication with Mr. E. G. Blackford, who assisted him in securing a supply from Greenwood Lake. These were carried to England with but little loss, and divided between several parties who had made preparations to take care of them.

n. **The White Perch** (*Morone americanas*).

The Quantico Station.—During the stay of the Fish Hawk at Quantico there were taken in the shad seines 34 male perch and 39 female in a ripe condition. These yielded 1,630,000 embryonized eggs. From these eggs there were hatched 180,000 fry, which were deposited in Quantico Creek.

Record of perch-hatching operations conducted by the United States Fish Commission steamer Fish Hawk, Lieut. Z. L. Tanner, United States Navy, commanding, at Quantico Creek, from April 12 to May 5, 1882.

Date.	Perch taken.		Eggs obtained.	Eggs lost.	Returned to local waters.	Used in experiments.
	Male.	Female.				
1882.						
Apr. 12	1	3	40,000	10,000	.....	.....
15	2	2	50,000	50,000	.....	.....
17	2	2	100,000	100,000	.....	.....
18	4	3	100,000	.....	.....	100,000
19	1	1	40,000	.....	.....	40,000
20	4	3	150,000	150,000	80,000	.....
20	2	1	100,000	100,000	.....	.....
21	1	2	50,000	50,000	.....	.....
22	1	1	50,000	50,000	.....	.....
26	1	2	25,000	25,000	.....	.....
27	2	6	400,000	400,000	.....	.....
28	3	2	75,000	75,000	.....	.....
29	2	2	50,000	50,000	.....	.....
30	6	6	300,000	150,000	.....	.....
May 5	2	3	100,000	100,000	150,000	.....
	34	39	1,630,000	1,310,000	180,000	140,000

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

Saint Jerome Station.—The work of experimenting with the artificial incubation of the eggs of *Ostrea virginica* was carried on at the Saint Jerome Creek Station during the summer of 1882, under the direction of Mr. John A. Ryder. These researches have been discussed at some length in a paper by Mr. Ryder, entitled "An account of the experiments in Oyster Culture, and observations relating thereto, second series" in the present report (pages 763–778), to which the reader is referred for further details.

The following brief summary of the results obtained may, however, not be out of place. All of the experiments were conducted with a view to keeping the artificially fertilized eggs of the oyster in receptacles of moderate capacity and under cover, so as to be readily accessible, while the water was either renewed on the embryo by hand or was aerated and kept in continuous circulation through an endless chain of vessels. Various forms of filters were tried without much success in the efforts to renew the water on the minute and delicate embryos, but these were unsatisfactory, and finally gave place to a system of vessels in which the same water was kept in continuous movement. On the 22d of July a lot of embryos placed in such an apparatus were found to have become attached to the sides of the vessels by the next day. This is apparently the first brood of artificially fertilized oyster embryos which are reported to have attached themselves, though it was not found practicable to keep them alive beyond a period of about three days.

It proved that it was not safe to alter the specific gravity of the water which was normal to the eggs and spermatozoa by artificial means, as such changes seemed to kill both. Putrescent action was prevented by using large volumes of water, into which a moderate proportion of eggs was introduced.

These developments, together with what had been learned during the seasons of 1879, 1880, and 1881, lead up to the attempt to utilize artificial fertilization with practical success in 1883.

In order to enable Mr. Ryder to investigate the alleged differences in the anatomy of the American oyster and the several European species and varieties. Mr. Blackford provided a quite complete collection of the latter, which furnished the basis of some important researches. Mr. Blackford also furnished several barrels of small seed-oysters to Mr. House, of Corinne, Utah, to be planted as an experiment in Great Salt Lake. No report of the result has, however, been furnished.

D.—ABSTRACT OF THE ARTICLES IN THE APPENDIX.

25.—Classification of Articles.

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

A.—General.

The first paper is by Lieut. Z. L. Tanner, illustrated by three plates, and gives an account of the Fish Hawk's work during the third year of its service. A similar paper by Lieut. W. M. Wood gives an account of the work done by the Lookout while under his command. A paper prepared from notes of the late F. S. Eastman, with six plates, illustrates the new Fish Commission car. Colonel McDonald discussed the subject of fish-ways. A foreign estimate of the United States exhibit at Berlin is reprinted from a German publication. Mr. Smiley has arranged for reference: (1) a list of the (1,817) principal lakes of the United States, with an index; and (2) a list in systematic order of the principal rivers of the United States, and containing nearly six thousand items.

B.—The Fisheries.

This contains papers on the whale fisheries, by F. C. Sanford and Thomas Southwell; extracts from the Scotch Fishery Board's report on the Scotch fisheries, apparatus, &c.; a history of the Tile fish, by Captain Collins, with a special index and two plates; and note on the preservation of nets and sails, by Prof. F. H. Storer, of Boston.

C.—Natural History and Biological Research.

In this section are presented: (1) Notes on various species of sea birds which are used for bait, by Captain Collins, with one figure and an index; (2) a list of the fishes collected by the Fish Commission at Wood's Holl in 1881, by Dr. T. H. Bean; (3) a report on the Decapod crustacea of the Albatross dredgings in 1883, by Sidney I. Smith, with ten plates and an index; (4) a translation of V. Hensen's paper on the eggs of the plaice, flounder, and cod, with one figure; (5) an important contribution to the embryography of osseous fishes, by J. A. Ryder, with twelve plates and an index; (6) directions for preserving embryonic materials for microscopic analysis, by the same author; (7) notes upon the principal aquaria of Europe in 1875, by Professor Blake, of Yale College; and (8) some notes upon the marine fauna of the New England coast and Vineyard Sound, by Professor Verrill, of Yale College, with a special index thereto.

D.—THE OYSTER.

In continuation of the data introduced in the report of 1880 upon this subject will be found six papers, by Bouchon-Brandely, Brocchi, Winslow, Ryder, and Puységur. The first two are translations from the French and treat of French experiments. The three following articles indicate what is being done in this matter by our own investigators under the auspices of this Commission. Several illustrations accompany these papers.

E.—PROPAGATION OF FOOD-FISHES.

Under this head will be found detailed and statistical reports upon the work of the United States Fish Commission in propagating and distributing food-fishes, such as shad, herring, white-fish, trout, and several kinds of salmon, by F. N. Clark, Livingston Stone, Charles G. Atkins, W. M. Wood, Fred. Mather, M. McDonald, and Chas. W. Smiley. There is also a report by Mr. Mather upon eggs shipped to Europe.

Upon the subject of carp culture will be found a translation from the German of Karl Nicklas's observations upon artificial feeding of carp; a report by Chas. W. Smiley of the distribution in 1879 and 1880 of carp reared by the Fish Commission, and of the distribution in 1881, by M. McDonald.

F.—MISCELLANEOUS.

This section contains a report by Capt. J. W. Collins upon a cruise of the Fish Hawk in Chesapeake Bay; an article by Prof. A. E. Verrill upon the physical characters of the continental border of the Gulf Stream as revealed by the Fish Hawk explorations, 1880–'82; a list of fishes propagated by the United States Fish Commission by Dr. T. H. Bean; and an alphabetical index of the names of the six thousand rivers of the United States treated under Appendix A by Chas. W. Smiley.

E.—SUPPLEMENT TO THE REPORT PROPER.

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

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

List of light-houses on the Atlantic coast at which ocean temperatures have been taken during the year 1882, 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:
James A. Morris, Southwest Harbor, Me. (succeeded by Thomas Milan in October)..... 12
Martinicus Rock light-house, Penobscot Bay:
William G. Grant, Martinicus, Me..... 12

Seguin light-house, Seguin Island, Kennebec River:
Thomas Day, Hunnewell's Point, Me..... 12
Boone 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:
Heman F. Smith, Provincetown, Mass. (succeeded by James Cushman in December..... 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..... 10
Cross Rip light-station, Vineyard Sound:
Luther Eldredge, Chatham, Mass..... 9
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 Milk street, New Bedford, Mass..... 11
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..... 12
Absecom light-house, Absecom Inlet:
A. G. Wolfe, Atlantic City, N. J..... 12
Five Fathom Bank light-station, off Delaware Bay:
Daniel Manlove, Cape May City, N. J. (succeeded by Wm. W. Smith in September)..... 12
Fourteen-Foot Bank light-station, Delaware Bay:
John Lund, Wilmington, Del. (succeeded by Ed. A. Howell, Delaware City, in June, 1882)..... 12
Winter-Quarter Shoal light-station, Chincoteague Island:
C. Lindermann, Chincoteague Island, Accomack County, Virginia..... 12
York Spit light-house:
James K. Hudgins, Port Haywood Va..... 7
Wolf Trap Bar, Chesapeake Bay, Virginia:
John L. Burroughs, New Point, Matthews County, Virginia..... 12
Stingray Point light-house:
George W. Crittenden, Sandy Bottom, Va. (succeeded by C. S. Lankford in March)..... 12
Windmill Point, mouth of Rappahannock River:
James I. Williams, Hookumfair, Va..... 12
Bodie's Island light-house, north of Cape Hatteras:
Peter G. Gallop, Manteo, Dare County, North Carolina..... 11
Cape Lookout light-house, Cape Lookout:
Deward Rumley, Beaufort, N. C..... 12

27.—LIST OF RAILROADS GRANTING BAGGAGE-CAR FACILITIES IN 1882.

During the present year a large number of railroads have accorded the facilities for carrying fish in baggage cars and for stopping trains at bridges so as to deposit young fish. The list is given herewith, and the most hearty acknowledgment made of their interest and co-operation.

Alabama Great Southern Railroad Company. Charles B. Wallace, superintendent, Chattanooga, Tenn.

Associated Railways of Virginia and the Carolinas. A. Pope, general passenger agent, Richmond, Va.

Atchison, Topeka and Santa Fé Railroad. W. S. Mellen, assistant general manager, Topeka, Kans.

Atlanta and West Point Railroad. A. J. Orme, general passenger agent, Atlanta, Ga.

Baltimore and Ohio Railroad Company. Thomas M. King, general superintendent Pittsburgh division; B. Dunham, superintendent Trans-Ohio division; W. M. Clements, master of transportation.

Boston and New York Air-Line Railroad Company. J. H. Franklin, superintendent, New Haven, Conn.

Boston and Albany Railroad. C. O. Russell, superintendent, Springfield, Mass.

Boston and Providence Railroad Company. A. A. Folsom, superintendent, Boston, Mass.

Burlington and Missouri River Railroad in Nebraska. G. W. Holdrige, general superintendent, Omaha.

Carolina Central Railroad. W. Q. Johnson, general superintendent, Wilmington, N. C.

Central Railroad of New Jersey. James Moore, general superintendent and engineer, Elizabeth, N. J.; F. S. Lathrop, receiver.

Central Railroad and Banking Company of Georgia. William Rogers, general superintendent, Savannah, Ga.

Central Vermont Railroad Company. J. W. Hobart, general superintendent, Saint Albans, Vt.

Charlotte, Columbia and Augusta Railroad Company. T. M. R. Talcott, general manager; A. Pope, general passenger agent, Richmond, Va.

Cheraw and Darlington, and Cheraw and Salisbury Railroads. J. F. Divine, general superintendent; A. Pope, general passenger agent, Richmond, Va.

Chesapeake and Ohio Railway Company. C. W. Smith, general manager, Richmond, Va.

Chicago, Rock Island and Pacific Railroad Company. A. Kimball, general superintendent, Davenport, Iowa.

Chicago and Alton Railroad. J. C. McMullin, general manager, Chicago, Ill.

Chicago, Saint Louis and New Orleans Railroad Company. W. H. Osborn, president; J. C. Clarke, vice-president and general manager, New York.

Chicago and Northwestern Railway. I. D. Layng, general superintendent, Chicago, Ill.

Chicago, Burlington and Quincy Railroad Company. T. J. Potter, general manager, Chicago, Ill.

Chicago, Saint Paul, Minneapolis and Omaha Railroad, and North Wisconsin Railroad. Charles F. Hatch, general superintendent, Saint Paul, Minn.

Cincinnati, Hamilton and Dayton; Dayton and Michigan; Cincinnati, Hamilton and Indianapolis; and Cincinnati, Richmond and Chicago Railroads. L. Williams, general manager, Cincinnati, Ohio.

Cincinnati, Sandusky and Cleveland Railroad. D. W. C. Brown, general manager and superintendent, Springfield, Ohio.

Cleveland, Columbus, Cincinnati and Indianapolis Railway Company. E. B. Thomas, general manager, Cleveland, Ohio.

Cleveland, Mount Vernon and Columbus Railroad Company. G. A. Jones, receiver, Mount Vernon, Ohio.

Columbia and Greenville Railroad. T. M. R. Talcott, general manager, Richmond, Va.

Connecticut River Railroad. J. Mulligan, superintendent, Springfield, Mass.

Delaware and Chesapeake Railway. O. S. Sandford, superintendent, Easton, Md.

Delaware, Lackawanna and Western Railroad. Samuel Sloan, president, New York.

East Tennessee, Virginia and Georgia Railroad. John F. O'Brien, chief engineer and superintendent, Knoxville, Tenn.

European and North American Railroad. F. W. Cram, superintendent, Bangor, Me.

Fitchburg Railroad Company. John Adams, general superintendent, Boston, Mass.

Flint and Pere Marquette Railway. Sanford Keeler, superintendent, East Saginaw, Mich.

Florida Central Railroad Company. W. M. Davidson, superintendent, Jacksonville, Fla.

Fort Wayne and Jackson Railroad Company. M. D. Woodford, general superintendent, Jackson, Mich.

Galveston, Harrisburg and San Antonio Railroad Company. James Converse, general superintendent.

Georgia Railroad Company. E. R. Dorsey, general freight and passenger agent, Augusta, Ga.

Gulf, Western Texas and Pacific Railroad. M. D. Monserrate, general superintendent, Cuero, Tex.

Hannibal and Saint Joseph Railroad Company. W. R. Woodard, superintendent, Hannibal, Mo.

Hartford and Connecticut Valley Railroad Company. Samuel Babcock, president, Hartford, Conn.

Houston and Texas Central Railroad. G. Jordan, vice-president, Houston, Tex.

Indianapolis and Saint Louis Railroad Company. E. B. McClure, general superintendent, Indianapolis, Ind.

Illinois Central Railroad Company. Joseph F. Tucker, traffic manager, Chicago, Ill.

Jacksonville, Pensacola and Mobile Railroad. John P. Laird, superintendent, Tallahassee, Fla.

Kansas City, Fort Scott and Gulf Railroad; Kansas City, Lawrence and Southern Railroad. L. W. Towne, superintendent, Kansas City, Mo.

Kansas City, Saint Joseph and Council Bluffs Railroad Company. I. F. Barnard, general superintendent, Saint Joseph, Mo.

Keokuk and Saint Louis Line. J. H. Best, general freight and passenger agent, J. W. Smith, superintendent, Keokuk, Iowa.

Lake Shore and Michigan Southern Railroad. P. P. Wright, general superintendent, Cleveland, Ohio.

Little Rock and Fort Smith Railway. Theodore Hartman, general superintendent, Little Rock, Ark.

Louisville and Nashville Railroad. D. W. C. Rowland, general superintendent, Louisville, Ky.

Montgomery and Eufaula Railroad. William Rogers, general superintendent, Montgomery, Ala.

Marietta and Cincinnati Railroad. J. H. Stewart, receiver, Cincinnati, Ohio.

Memphis and Little Rock Railroad. E. K. Sibley, general manager, Little Rock, Ark.

Missouri Pacific Railway. A. A. Talmage, general manager, Saint Louis, Mo.

Mississippi and Tennessee Railroad. M. Burke, general superintendent, Memphis, Tenn.

Mobile and Ohio Railroad. A. L. Rives, general manager, Mobile, Ala.

Nashville, Chattanooga and Saint Louis Railway. J. W. Thomas, general superintendent, Nashville, Tenn.

New York, Lake Erie and Western Railroad. B. Thomas, superintendent of transportation, New York.

New York and New England Railroad Company. A. C. Kendall, general passenger agent; O. M. Shepard, superintendent of transportation, Boston; J. H. Wilson, vice-president.

New York, New Haven and Hartford Railroad Company. E. M. Reed, vice-president, New York.

New York, Pennsylvania and Ohio Railroad. P. D. Cooper, general superintendent, Cleveland, Ohio.

Northern Central Railway Company; Baltimore and Potomac Railroad; and Alexandria and Fredericksburg Railway. J. R. Wood, general passenger agent, Philadelphia, Pa.

Northeastern Railroad of Georgia. H. R. Bernard, superintendent, Athens, Ga.

Ohio and Mississippi Railway Company. W. W. Peabody, general superintendent, Cincinnati, Ohio.

Old Colony Railroad Company. J. R. Kendrick, superintendent, Boston, Mass.

Pennsylvania Company. D. W. Caldwell, general manager, Pittsburgh, Pa.

Pennsylvania Railroad Company. J. R. Wood, general passenger agent, Philadelphia, Pa.

Petersburg Railroad Company. R. M. Sully, general superintendent, Petersburg, Va.

Pittsburgh, Cincinnati and Saint Louis Railway Company. D. W. Caldwell, general manager, Columbus, Ohio.

Richmond and Danville Railroad. T. M. R. Talcott, general manager, Richmond, Va.

Richmond and Petersburg Railroad Company. Theo. D. Kline, general superintendent, Richmond, Va.

Richmond, Fredericksburg and Potomac Railroad Company. E. T. D. Myers, general superintendent, Richmond, Va.

Savannah, Griffin and North Alabama Railroad. William Rogers, general superintendent, Savannah, Ga.

Savannah and Memphis Railroad Company. W. C. Fowler, cashier, Opelika, Ala.

Savannah and Charleston Railroad Company. C. S. Gadsden, engineer and superintendent, Charleston, S. C.

Savannah, Florida and Western Railway Company. R. G. Fleming, superintendent, Savannah, Ga.

Seaboard and Roanoke Railroad Company; Raleigh and Gaston Railroad Company; Raleigh and Augusta Air-Line Railroad Company; Baltimore Steam Packet Company; Albemarle Steam Navigation Company. John M. Robinson, president, Baltimore, Md.

Southwestern Railroad of Georgia. William Rogers, superintendent, Macon, Ga.

South Carolina Railroad. John B. Peck, general superintendent, Charleston, S. C.

Saint Louis and San Francisco Railway. C. W. Rogers, general manager, Saint Louis, Mo.

Saint Louis, Iron Mountain and Southern Railway. H. M. Hoxie, general manager, Saint Louis, Mo.

Saint Paul, Minneapolis and Manitoba Railway. A. Manvel, assistant general manager, Saint Paul, Minn.

Texas and Pacific Railway Company. George Noble, general superintendent, Marshall, Tex.

Texas and New Orleans Railroad. J. F. Crosby, vice-president and general manager, Houston, Tex.

Union Pacific Railway. Thomas L. Kimball, assistant general manager, Omaha.

Virginia Midland Railway Company. W. M. S. Dunn, engineer and superintendent, Alexandria, Va.

Vandalia Line; Terre Haute and Indianapolis Railroad Company. D. W. Caldwell, general manager, Saint Louis, Mo.

Vicksburg and Meridian Railroad Company. E. F. Raworth, general superintendent, Vicksburg, Miss.

Wabash, Saint Louis and Pacific Railway. John C. Gault, general manager, Saint Louis, Mo.

Western and Atlantic Railroad Company. William MacRae, general manager, Atlanta, Ga,

Western North Carolina Railroad. James W. Wilson, president, Morganton, N. C.

Western Railroad of Alabama. Cecil Gabbett, general manager, Montgomery, Ala.

West Jersey Railroad Company, passenger department. L. P. Farmer, general passenger agent, Philadelphia, Pa.

Western Maryland Railroad Company. J. M. Hood, general manager, Baltimore, Md.

Wilmington and Weldon; and Wilmington, Columbia and Augusta Railroads. A. Pope, general passenger agent, Wilmington, N. C.; John F. Divine, general superintendent.

Wisconsin Central Railroad Company. F. N. Finney, general manager, Milwaukee, Wis.

28.—LIST OF RAILROADS THAT MOVED CARS, AND MESSENGERS TO THE NUMBER OF FIVE ACCOMPANYING, AT THE RATE OF TWENTY CENTS A MILE DURING THE YEAR 1882.

Alabama Great Southern Railway; Chattanooga, Tenn.
Atlanta and West Point Railroad; Atlanta, Ga.
Baltimore and Ohio Railroad; Baltimore, Md.
Chesapeake and Ohio Railway; Richmond, Va.
Chicago, Burlington and Quincy Railroad; Chicago, Ill.
Chicago and Northwestern 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.

Kansas City, Saint Joseph and Council Bluffs Railroad Company. I. F. Barnard, general superintendent, Saint Joseph, Mo.

Keokuk and Saint Louis Line. J. H. Best, general freight and passenger agent, J. W. Smith, superintendent, Keokuk, Iowa.

Lake Shore and Michigan Southern Railroad. P. P. Wright, general superintendent, Cleveland, Ohio.

Little Rock and Fort Smith Railway. Theodore Hartman, general superintendent, Little Rock, Ark.

Louisville and Nashville Railroad. D. W. C. Rowland, general superintendent, Louisville, Ky.

Montgomery and Eufaula Railroad. William Rogers, general superintendent, Montgomery, Ala.

Marietta and Cincinnati Railroad. J. H. Stewart, receiver, Cincinnati, Ohio.

Memphis and Little Rock Railroad. E. K. Sibley, general manager, Little Rock, Ark.

Missouri Pacific Railway. A. A. Talmage, general manager, Saint Louis, Mo.

Mississippi and Tennessee Railroad. M. Burke, general superintendent, Memphis, Tenn.

Mobile and Ohio Railroad. A. L. Rives, general manager, Mobile, Ala.

Nashville, Chattanooga and Saint Louis Railway. J. W. Thomas, general superintendent, Nashville, Tenn.

New York, Lake Erie and Western Railroad. B. Thomas, superintendent of transportation, New York.

New York and New England Railroad Company. A. C. Kendall, general passenger agent; O. M. Shepard, superintendent of transportation, Boston; J. H. Wilson, vice-president.

New York, New Haven and Hartford Railroad Company. E. M. Reed, vice-president, New York.

New York, Pennsylvania and Ohio Railroad. P. D. Cooper, general superintendent, Cleveland, Ohio.

Northern Central Railway Company; Baltimore and Potomac Railroad; and Alexandria and Fredericksburg Railway. J. R. Wood, general passenger agent, Philadelphia, Pa.

Northeastern Railroad of Georgia. H. R. Bernard, superintendent, Athens, Ga.

Ohio and Mississippi Railway Company. W. W. Peabody, general superintendent, Cincinnati, Ohio.

Old Colony Railroad Company. J. R. Kendrick, superintendent, Boston, Mass.

Pennsylvania Company. D. W. Caldwell, general manager, Pittsburgh, Pa.

Pennsylvania Railroad Company. J. R. Wood, general passenger agent, Philadelphia, Pa.

Petersburg Railroad Company. R. M. Sully, general superintendent, Petersburg, Va.

Pittsburgh, Cincinnati and Saint Louis Railway Company. D. W. Caldwell, general manager, Columbus, Ohio.

Richmond and Danville Railroad. T. M. R. Talcott, general manager, Richmond, Va.

Richmond and Petersburg Railroad Company. Theo. D. Kline, general superintendent, Richmond, Va.

Richmond, Fredericksburg and Potomac Railroad Company. E. T. D. Myers, general superintendent, Richmond, Va.

Savannah, Griffin and North Alabama Railroad. William Rogers, general superintendent, Savannah, Ga.

Savannah and Memphis Railroad Company. W. C. Fowler, cashier, Opelika, Ala.

Savannah and Charleston Railroad Company. C. S. Gadsden, engineer and superintendent, Charleston, S. C.

Savannah, Florida and Western Railway Company. R. G. Fleming, superintendent, Savannah, Ga.

Seaboard and Roanoke Railroad Company; Raleigh and Gaston Railroad Company; Raleigh and Augusta Air-Line Railroad Company; Baltimore Steam Packet Company; Albemarle Steam Navigation Company. John M. Robinson, president, Baltimore, Md.

Southwestern Railroad of Georgia. William Rogers, superintendent, Macon, Ga.

South Carolina Railroad. John B. Peck, general superintendent, Charleston, S. C.

Saint Louis and San Francisco Railway. C. W. Rogers, general manager, Saint Louis, Mo.

Saint Louis, Iron Mountain and Southern Railway. H. M. Hoxie, general manager, Saint Louis, Mo.

Saint Paul, Minneapolis and Manitoba Railway. A. Manvel, assistant general manager, Saint Paul, Minn.

Texas and Pacific Railway Company. George Noble, general superintendent, Marshall, Tex.

Texas and New Orleans Railroad. J. F. Crosby, vice-president and general manager, Houston, Tex.

Union Pacific Railway. Thomas L. Kimball, assistant general manager, Omaha.

Virginia Midland Railway Company. W. M. S. Dunn, engineer and superintendent, Alexandria, Va.

Vandalia Line; Terre Haute and Indianapolis Railroad Company. D. W. Caldwell, general manager, Saint Louis, Mo.

Vicksburg and Meridian Railroad Company. E. F. Raworth, general superintendent, Vicksburg, Miss.

Wabash, Saint Louis and Pacific Railway. John C. Gault, general manager, Saint Louis, Mo.

Western and Atlantic Railroad Company. William MacRae, general manager, Atlanta, Ga,

Western North Carolina Railroad. James W. Wilson, president, Morganton, N. C.

Western Railroad of Alabama. Cecil Gabbett, general manager, Montgomery, Ala.

West Jersey Railroad Company, passenger department. L. P. Farmer, general passenger agent, Philadelphia, Pa.

Western Maryland Railroad Company. J. M. Hood, general manager, Baltimore, Md.

Wilmington and Weldon; and Wilmington, Columbia and Augusta Railroads. A. Pope, general passenger agent, Wilmington, N. C.; John F. Divine, general superintendent.

Wisconsin Central Railroad Company. F. N. Finney, general manager, Milwaukee, Wis.

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Chicago and Northwestern 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.