REPORT OF COMMISSIONER.

The duties intrusted to the United States Commissioner of Fish and Fisheries, as established by joint resolution of the Senate and House of Representatives of the United States the 9th of February, 1871, are twofold: first, an investigation into the cause of the decrease of the sea-coast fishes and those of the rivers and lakes, with suggestions as to the best methods of restoring the same; second, active measures looking toward the propagation and multiplication of the useful food-fishes, either by restocking depleted waters or by introducing desirable species into new localities.

In the two reports already published will be found a history of the measures adopted to accomplish these ends during the years 1871, 1872, and the first half of 1873; and I now proceed to give the history of the labors of the commission from July 1, 1873, to July 1, 1875.*

A—INQUIRY INTO THE DECREASE OF FOOD-FISHES.

1.—INVESTIGATIONS IN 1873.

The labors of the Commission commenced at Wood's Hole, Massachusetts, in 1871, while the season of 1872 was passed at Eastport, in the Bay of Fundy. For the purpose of more completely developing the economical and natural history of the coast of Maine, the chief seat of the herring and cod fisheries, Portland was selected as a second station in that State from which to prosecute the inquiries of the Commission in 1873. Quarters were accordingly secured at Peak's Island, about three miles from the city, where a wharf, with buildings, and good anchorage near by, furnished the necessary facilities.

The law of Congress authorizing the Commission instructs the heads of all the Government departments to render it such assistance as may be in their power; and, in obedience to this requirement, the Secretary of the Navy granted the use of a stanch vessel of about 100 feet in length and nearly one hundred tons burden, then stationed at the Washington navy-yard, and not required at the time for other purposes—the steam-tug Blue Light. Commander L. A. Beardslee, of the U. S. Navy,

* The printing of the reports for the years 1873–4 and 1874–5 was ordered separately by Congress; but no provision having been made for extras, and unavoidable delays having occurred in the printing, it has been thought best to publish the two in a single volume.

was placed in charge of the vessel, and a suitable crew furnished from the navy-yard.

Various alterations were made in the vessel to better adapt her for the purposes to which she was to be applied. A pilot-house was erected on the upper deck, the old one being converted into a laboratory, and a small donkey-engine placed on the forward part of the deck to work the dredge and trawl. Leaving Washington in charge of her commander on the 28th of June, the Blue Light reported at Peak's Island for duty on the 8th of July. She proved to be everything that could be desired for her purposes; her light draught (about 7 feet) enabling her to run into the bays and harbors along the coast, and her seaworthiness to go off considerable distances to the outer banks. As on previous occasions, Professor Verrill, of Yale College, took the more immediate charge of the researches into the invertebrates, while numerous specialists were also members of the party for a greater or less length of time, among whom were Prof. Sidney J. Smith, of New Haven; Prof. J. E. Todd, of Tabor College, Iowa; Prof. E. T. Nelson, of Delaware College, Ohio; Prof. E. N. Rice, of the Wesleyan University, Middletown; Dr. P. P. Carpenter, of Montreal; Dr. J. B. Holder, of the American Museum, Central Park, New York; Mr. G. Brown Goode, curator of the museum of the University of Middletown, Conn.; Prof. Theodore Gill and Dr. E. Palmer, of Washington; Mr. J. E. Thacher, of New Haven; Mr. C. B. Fuller, of Portland; Mr. Spencer F. Biddle, of Philadelphia, and others.

The work of investigation into the general and economical history of the fishes and other marine animals was prosecuted with unremitting energy, and resulted in the acquisition of many important collections and observations. According to a rough estimate, 62 species of fishes, 130 of articulates, 145 of worms, 215 of mollusks, 34 of radiates, 50 of acalèphs, 30 of sponges, and 50 of plants, or about 750 in all, were identified; while the number of minute crustaceans, and other diminutive objects, requiring further investigation, will probably amount to nearly as many more. The present history and statistics of the mackerel, cod, herring, alewives, menhaden, &c., was well worked out as far as peculiar to the coast. The contents of the stomachs of all the fishes taken, under different circumstances, were examined and recorded, and important generalizations reached as to the relationships between the fish, their food, and the differing regions of the sea-bottom. Among other collections made by the Commission were numerous specimens of a species of flounder, *Pleuronectes glaber*, known heretofore by only a single specimen described by Storer in his great work on the "Fishes of Massachusetts."

The collection of invertebrates embraced very many extremely interesting species, some of them entirely new, and others found for the first time on this coast. Among these may be mentioned a species of *Hyalonema*, *Holtenia*, and some other very remarkable siliceous sponges which have lately attracted much attention from naturalists. Some very rare

radiates were also secured, among them *Comatula*, *Cerianthus*, *Schizaster*, *Astrogonium*, &c.

The opportunity was of course embraced to study the habits and structures of the animals collected during the season and kept in aquaria; and the artist of the expedition, Mr. J. H. Emerton, made over 300 drawings of these from life mostly of species never before figured, excepting, possibly, a few from shriveled alcoholic specimens.

In addition to the biological researches, attention was paid to questions connected with the physics of the deep seas, this branch of the work being more particularly under the direction of Captain Beardslee, the commander of the steamer. These consisted of a determination of the temperature of the surface-, median-, and bottom-water, at numerous localities, and a daily record at the anchorage of the steamer off Peak's Island. Specimens of the water were also brought up from various depths and secured in well-sealed bottles for examination as to specific gravity, chemical composition, and gaseous constituents.

As on previous occasions, the occasion was made use of by some of the associates of the Commission and its visitors, to secure specimens for various public museums, principally those of colleges, among others an extensive collection was gathered by Dr. Holder for the American Museum of Natural History, Central Park, New York. After the collections have been thoroughly worked up a distribution of duplicates will be made from the stock reserved by the Commission.

Among the numerous visitors to the headquarters of the commission during its sojourn at Peak's Island, some of them members of the American Association for the Advancement of Science, attending its meeting at Portland, were Dr. J. W. Dawson, of Montreal; Messrs. Stilwell and Stanley, fish-commissioners of Maine; Mr. C. G. Atkins, of Bucksport; J. W. Milner, of Waukegan, Ill.; Professor Atwater, of Middletown, Conn.; Prof. Joseph Henry; Captain Walker, United States Navy; Mr. E. B. Elliot; Dr. T. M. Brewer, of Boston; J. W. Harper, of New York, and many others. Mr. W. C. Wyckoff, of the New York Tribune, spent much time on the island in making himself familiar with the operations of the Commission, embodying the results of his inquiries in a series of illustrated letters published by the Tribune in connection with the report of the proceedings of the American Association as one of its "lecture extras."

The Secretary of the Navy also visited the station, and spent several days in examining the operations of the Commission.

As already mentioned, the success of the operations of the season of 1873 was very greatly facilitated by the service of the Blue Light and her force. Special assistance was found in the steam-windlass for hoisting the dredges and trawls; besides saving labor, this permitted more frequent hauls in each day's excursion.

All the known forms of apparatus for deep-sea research were tried by the commission, including a full series of that used on the Porcupine

and the Challenger. Among these may be mentioned the so-called accumulator, a device by which sudden strain on the dredge-rope is relieved and its breakage prevented, the use of which, however, was entirely superseded by a very simple "check-stop" invented by Captain Beardslee—an arrangement perfectly available for all uses in moderate weather and at depths less than five hundred fathoms.

Among the most interesting regions explored, were the deeper waters outside of Casco Bay, fifteen to thirty miles southeast from Cape Elizabeth. Here the bottom was of soft mud, with more or less numerous scattered bowlders. The bottom temperature varied from 36° to 40°, while that of the surface was usually between 55° and 65°, or even higher. The temperatures obtained here proved to be quite as low as in the deeper parts of the Bay of Fundy, while the fauna was correspondingly Arctic in character. For full details, however, in regard to the physical and other peculiarities, relating more particularly to the marine invertebrates, the reader is referred to Professor Verrill's report.

In a zoölogical point of view, another most interesting locality worked up during the expedition, was a small sheltered cove at the upper end of Casco Bay, about thirty miles northeast of Portland, known as being inhabited by the round clam (*Venus mercenaria*), a species not found living elsewhere on the coast of Maine. A visit to that place showed a genuine colony of various species now met with only on the south side of New England. A critical examination of the specimens at present found there and elsewhere in the vicinity of Portland, proves, in Professor Verrill's opinion—first, that in the Post-Pliocene and Champlain periods the coast was at a lower level, and the marine climate of Casco Bay colder than at present, probably about that of the present Newfoundland or Labrador coast; second, that at a subsequent period, when the coast had attained nearly or quite its present level, the marine temperature was considerably higher than at present; third, that the temperature of these waters has gradually declined, but was still somewhat higher at the period when the Indian shell-heaps were formed than at present. A similar conclusion is reached by the examination of a colony of somewhat similar character on the Gulf of St. Lawrence. Professor Verrill ascribes the survival of these earliest colonies to the fact that in the increasing coldness of the water, which exterminated certain animal forms not fitted to such temperature, the peculiar isolation and physical condition of the localities in question were such as to protect the inhabitants from the general fate of their neighbors along the coast. He thinks the causes of such changes may have been entirely local, and due to changes in the relative level of land and water in adjacent regions.

For the purpose of making observations at a greater distance from the coast than could be reached by the Blue Light, Professor Peirce, Superintendent of the Coast Survey, kindly authorized the use of the Coast

Survey steamer Bache, for research in the outer waters between Mount Desert and Cape Cod.

The steamer was under the command of Captain Howell, and for a certain period under that of Lieutenant Jaques, while the scientific labors were conducted by Dr. A. S. Packard, jr., and Mr. Caleb Cook. Several successful cruises resulted in large collections of rare and little known invertebrates, including many Arctic forms previously unknown on the American coast. An especially interesting collection was made in the vicinity of Cashe's Ledge.

In addition to the above-mentioned assistance rendered the Fish Commission by the Navy Department and the United States Coast Survey, in compliance with the law of Congress, it should be stated that, as heretofore, the Secretary of the Treasury allowed the detail of the revenue-cutter of the station, (the McCullough, Captain Treadway commanding,) whenever she could be spared, and at a later period the use of the steamer Chase, on Lake Ontario, to assist Mr. Seth Green in securing the spawn of whitefish and salmon-trout, by carrying himself and his men to the fishing-stations and bringing back the eggs, which were then transferred to Rochester for treatment in behalf of the United States and the State of New York.

Further aid was rendered by the Quartermaster-General, who, by permission of the Secretary of War, furnished two tents for the use of Dr. Slack and his party while engaged in shad-hatching on the Delaware River, to be referred to hereafter.

2.—INVESTIGATIONS IN 1874.

In selecting a station for the purpose of prosecuting marine explorations during the year 1874, a locality was sought for sufficiently remote from any previously occupied to furnish additional data in reference to the extension and the geographical distribution of the food-fishes of the coast and the objects upon which they prey; and after a consultation with Professor Verrill, the associate of the Commission in this branch of the inquiry, the village of Noank, Conn., on Fisher's Sound, was chosen. This is situated in the town of Groton, New London County, at the mouth of Mystic River, about midway between New London and Stonington, and sufficiently remote from Wood's Hole, the station of the Commission in 1871, to permit some important zoölogical differences.

The station was reached with a portion of my party on the 29th of June, Professor Verrill and his assistants arriving shortly after, when I immediately proceeded to arrange for a laboratory in the usual manner. The steam-tug Blue Light, which had been laid up during the preceding winter at Portsmouth, N. H., was again kindly furnished to the Commission by the Secretary of the Navy, with Commander L. A. Beardslee, U. S. N., as before, in charge of the vessel, and reached Noank on the 10th of July, in excellent condition. As in previous years, the station of the Commission was visited by a large number of gentle-

men, many of them specialists in marine zoölogy, and others having a general interest in the objects of the Commission. During the season the Blue Light was continuously occupied on her trips, losing but little time for repairs or other purposes. The principal points visited by her, in addition to the waters adjacent to Noank, were Block Island, Gardiner's and Peconic Bay, Montauk Point, the mouth of the Connecticut, &c., a range of from thirty to forty miles from the starting-point.

Noank possesses special advantages for fishery inquiries, the inhabitants being engaged almost entirely in fishing, and a large number of smacks being owned at that place, some of which are employed in fishing off the Florida coast during the winter; but which in summer are all occupied in the vicinity, or in trips to the outer banks. Every day numerous cargoes of fish which were brought in for shipment to New York and elsewhere, furnished the means of studying the species in their varying condition of age and season. A full series was obtained for the collections of the Commission, either for photographing or modeling in plaster.

Experiments were made toward the end of July, by Mr. Fred Mather, in regard to the possibility of the artificial propagation of sea-bass (*Centropristes atrarius*), and a considerable number of eggs were successfully impregnated and placed in hatching-boxes. Unfortunately, however, it was found impossible without more extensive precautions than we were prepared to adopt to properly protect the boxes against the weather, and a severe storm at the end of July emptied the boxes and ended the experiment. The experiment, however, will be again tried, as it is believed that the process of artificial propagation is as available for the reproduction of many of the sea-fishes as for those of fresh water. Among these may be especially mentioned the sea-bass, the tautog, the striped bass, the scup, &c.

On the 22d of July, I visited the Holyoke shad-hatching station of the Commission, in charge of Mr. Milner, and found great activity prevailing, and a very successful effort in connection with the distribution of the fish.

On the 15th of August, Mr. Milner reached Noank, accompanied by Mr. Griswold, one of his assistants, for the purpose of testing the effect of the introduction of young shad into salt water, the details of which experiment will be found under the subject of "shad," and also in Mr. Milner's special report on the subject. It may, however, be here stated in general terms, that in adding salt water to the fresh in which the fish were kept, it was found that up to a certain percentage the fish were about as vigorous as in entirely fresh water, although a sudden transfer from fresh to salt water resulted in their speedy death.

With a view of ascertaining the length of time during which shad could be carried safely from one point to another, it was determined to try the experiment of forwarding a number of young fish to Europe, this answering the purpose of a test of the possibilities in the case. If the experiment met with success, the favor of the German government

in presenting to the United States a quarter of a million of the salmon of the Rhine could be reciprocated. Messrs. Fred Mather and A. A. Anderson were detailed for the purpose, and visited Noank on the beginning of August to receive instructions, the steamer leaving New York on the 5th of August. Unfortunately the experiment was a failure, the fish dying a few days after the vessel left. These gentlemen returned to Noank on the 11th of September for the purpose of presenting their report. Full reference to this subject will be found under the head of the subject of "Propagation of shad for 1874," and in an appendix, and further allusion to it here is necessary only to renew the reference to the great liberality of the North German Lloyd in granting free passage to the two gentlemen mentioned above, with their freight, to Bremen and return.

The steamer Blue Light went out of commission on the 9th of September, and was laid up, under the direction of the Secretary of the Navy, at New London; after which the work of the Commission was prosecuted almost entirely by means of sail and row boats.

Many interesting discoveries were made in the way of additions of previously unrecorded species on the coast, and in extending the area of the distribution of others. A general sketch of the results, so far as the invertebrates are concerned, will be found in an article by Professor Verrill.

The labors of the Commission at Noank extended over the months of July, August, and September. Professor Verrill and his party left early in September, but the other divisions were occupied until the beginning of October. Remaining a few days to settle up the business of the Commission, I left for Washington on the 8th of October.

The working party of the Commission, for the most part, consisted of the following gentlemen: Prof. A. E. Verrill, of Yale College, in charge of the dredging operations, and of the department of marine zoölogy, with the exception of the fishes, having as special assistants Prof. S. J. Smith, Mr. S. F. Clark, Mr. Turnbull, of Yale College, and Prof. N. S. Rice, of Wesleyan University, Middletown.

The department of the fishes was under the direction of Mr. G. Brown Goode, of the Smithsonian Institution, assisted by Mr. C. W. Schuermann and T. H. Bean of Washington, and Mr. H. C. Chester.

The algologists were Prof. D. C. Eaton, of Yale College, and Dr. W. G. Farlow, of Cambridge, assisted by Messrs. Livingston and Klaburger. Prof. A. Hyatt, of the Society of Natural History, Boston, with Mr. Richard Rathburn, and Mr. Saltonstall, of Boston, were also members of the party.

Among the visitors who devote more or less of their time to natural history investigations, and who availed themselves of the material provided by the Commission, or who desired to become acquainted with its methods, may be mentioned Dr. Joseph Leidy, Prof. Henry Chapman, and Dr. Horatio Allen, of Philadelphia; Prof. D. C. Jordan, of India-

napolis; Prof. F. W. Putnam, of Salem; General A. B. Eaton, Dr. Theodore Gill, and Dr. E. Bessels, of Washington; Mr. W. C. Wyckoff, and Dr. J. B. Holder, of New York; Mr. O. S. Westcott, of Chicago; Prof. J. Hammond Trumbull, and Dr. W. O. Ayres, of Hartford; Mr. W. T. Parker, and M. W. Humphrey, of West Meriden, Conn.

The State fish commissioners, or persons specially interested in fish-culture, visiting the station during the summer, were Messrs. Alfred Read, jr., Newton Dexter, and J. Barden, of Rhode Island; Dr. M. C. Edmunds, of Vermont; Dr. W. W. Fletcher, of New Hampshire; G. C. Anderson, of New Jersey; Mr. J. W. Milner, Fred Mather, A. A. Anderson, and C. D. Griswold, of the United States Fish Commission.

The results of Professor Verrill's labors, and those of his associates in the department of marine natural history and plants, will be furnished in a special report; although it may be proper here to state that over one hundred species of invertebrates, new to the fauna of New England, were secured, most of them northern species, and many undescribed.

The principal localities over which dredgings were made were Fisher's Island Sound; Block Island Sound; off Block Island and south of Montauk Point; the eastern part of Long Island Sound; from Fisher's Island and Gardiner's Island to the mouth of the Connecticut River; the shallow waters in the harbors and estuaries near Noank; Gardiner's Bay, Long Island; Great Peconic and Little Peconic Bays and Greenport Harbor, Long Island. These latter localities showed temperatures much higher than the others, and furnished correspondingly southern types of animal life.

It was clearly shown by the investigations of the Commission that there is a very decided flow of cold currents through Fisher's Island Sound and Block Island Sound into Long Island Sound, and along the deeper parts of the latter for a great distance, especially toward the southern and deeper side. The influence of this cold current is very apparent as far west as New Haven in the deeper parts of the sound. According to Professor Verrill its flowing into Long Island Sound is due largely to the influence of the tidal currents modified by the local wind-currents. On the other hand, the much higher temperature of such inclosed localities as the Peconic Bays may be safely attributed to the direct heat of the sun over a broad expanse of shallow water, from which the cold currents are excluded.

As in previous years assistance was rendered by the Coast Survey in carrying on operations at distances remote from the coast, and which the Blue Light was not suited to reach. A part of the month of September was occupied by the steamer Bache, under command of Captain Platt, in dredging operations off the coast of Maine. The scientific work was in charge of Dr. A. S. Packard, assisted by Mr. C. Cook and Mr. Robert Rathburn. Dredgings at about forty stations were made off the coasts of Maine and New Hampshire, at various depths, down to

125 fathoms. The results of this investigation will also be found in Professor Verrill's report.

The attention of Professor Verrill and his party, especially of Prof. W. N. Rice, was directed to investigations as to the best method of preserving the invertebrates for museum purposes, and to improved methods for killing in an expanded state such species as usually contract when placed in alcohol. In regard to the preservation of *Actiniæ* very satisfactory results were obtained by slowly adding a saturated solution of picric acid to a small quantity of sea-water in which they had been allowed to expand. When fairly dead they were transferred to a pure saturated solution of the acid and allowed to remain from one to three hours, according to size. They were then placed in alcohol of about 60 to 70 per cent. for permanent preservation. The alcohol should be renewed after a day or two, and this repeated until the water is all absorbed from the specimen.

It was found that hydroids and most kinds of jelly-fishes can be easily and beautifully preserved in the same way, but of these the specimens may usually be placed alive directly in the acid of full strength. The success with osmic acid was not so marked, the specimens contracting more, and finally becoming so darkly stained as to render them useless. Various trials were made with different kinds of drugs for the purpose of killing marine animals in an expanded state, but no better method was discovered than that of allowing them to suffocate in stale sea-water

B—THE PROPAGATION OF FOOD-FISHES.

3.—EXTENT OF THE WORK.

The work of propagation and distribution of food-fishes has been enlarged year by year. Applications have been received from all of the States and from four Territories. This has necessitated a continual expansion of the plans for each season's work.

The work of the United States Fish Commission in multiplying useful food-fishes was commenced in 1872, and has been prosecuted with satisfactory results up to the present time.

The species to which special attention has been directed are the shad (*Alosa sapidissima*,) fresh-water herring or alewive, (*Pomolobus pseudoharengus*,) striped bass or rock-fish (*Roccus lineatus*,) California salmon (*Salmo quinnat*,) the salmon of Maine (*Salmo salar*,) land-locked salmon (*Salmo sebago*,) white-fish (*Coregonus albus*,) and the carp (*Cyprinus carpio* and var.,) each of these having special relations to certain portions of the country, and promising in their anticipated aggregate an extremely important addition to the food-resources of the United States.

The States which have so far been the direct recipients of spawn and young fish of more or less of these species are Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, the District of Columbia,

Virginia, West Virginia, North Carolina, South Carolina, Georgia, Louisiana, Mississippi, Missouri, Texas, Tennessee, Kentucky, Ohio, Illinois, Indiana, Michigan, Wisconsin, Minnesota, Iowa, Utah, Nebraska, Colorado, and California; while other States, as Alabama and Arkansas, which have not been the actual scene of the operations of the Commission, have been indirectly benefited by the introduction of fish into their waters at points outside of the State limits, thrty-three States and two Territories in all. The extension of the work to other States and its amplification in all is only a question of time.

The operations of the Commission have, it is believed, given entire satisfaction to the people at large, as shown by the general popularity of the measures adopted, the great interest excited in the subject throughout the country, and the appointment of State fish commissions in nineteen States, in most instances for the purpose of directly co-operating with the United States Commission in its efforts to secure from the waters their fullest yield of animal food. This has rightly been considered an object of the greatest importance in view of the rapidly-increasing population of the United States and the almost corresponding diminution in the average yield of vegetable food by the farming-lands, and it is not considered exaggeration to say that the water can be made to yield a larger percentage of nutriment, acre for acre, than the land.

A further evidence of the importance of this effort is shown by the fact that China, with its enormous population, greater to the square mile than that of any other part of the world, derives the largest portion of its animal food from the interior waters of the empire, the methods of fish-cultivation there being conducted in a very efficient manner, and every cubic yard of pond and stream thoroughly utilized.

It is well to bear in mind that the work prosecuted by the United States Commission is in no case that which would be carried on by State commissions or by private enterprise. The States of Iowa, Minnesota, Ohio, or Pennsylvania would not find their advantage in going to any great expense in the way of stocking their streams in view of the fact that the fish, when mature, would, on their return, enter the mouth of the Mississippi and traverse all the intermediate States before arriving within their borders, with the certainty that a large portion of the catch would be secured by citizens of other States. On the other hand, the young and immature fish, requiring the cold upper sources of the streams as their home, will not find in the great waters of the more Southern States the proper conditions for their preservation and growth. Furthermore, the primary outlay for securing the eggs of such species as the California salmon, &c., is greater than single States can meet, while the cost of obtaining a supply for the entire country at a single establishment is much less proportionately than the aggregate cost of separate effort.

The plan as regards the propagation of shad is to establish hatching-camps in March on the southernmost streams on the Atlantic

slope, there to hatch all the eggs that can be procured, and, placing a portion of the young fish in the stream where they are procured, to transmit the remainder to other waters now entirely unprovided. This operation would be continued by removing the camps northward as the season advanced until the Connecticut River is reached, toward the end of June, and from which the States along the Great Lakes, the Upper Mississippi, and the Pacific coast would be supplied.

The California salmon is a species which can withstand the warmest regions of the United States, and is extremely hardy and prolific, and its multiplication is considered extremely important. Some idea of the scale on which the work of the commission connected with this species has been conducted can be formed from the fact that the eggs collected during the season of 1875 at the United States establishment on the Upper Sacramento numbered about 11,000,000, with a bulk of 80 bushels, and weighing, with the packing in which they were transported to eastern establishments, nearly 10 tons.

In further illustration of the results that may be looked for from a judicious and systematic prosecution of the work of propagating the food-fishes, we may refer to the Potomac River, in which from six to ten million pounds of shad and herring are taken during the spring months alone. There is no reason why any stream in the United States having direct communication with the Gulf of Mexico, or either ocean, may not be made to abound in an equal degree with these and other fishes, and in view of the aggregate of the animal food to be derived from a number of such streams, the importance of this work can hardly be overestimated.*

Another fish to which it is proposed to devote the efforts of the Commission is the European carp, a species eminently calculated for the warmer waters of the country, especially the mill-ponds and sluggish rivers and ditches of the South. This fish has been domesticated for thousands of years, and is one of the species which furnish the principal food of the Chinese. Living on vegetable matter instead of animal, it can be multiplied at very little expense in restricted waters.

It is not alone to the introduction of suitable fishes into water previously uninhabited by them that the efforts of the Commission are directed, but also toward restoring a full supply to streams where they were formerly abundant. At one time all the rivers on the Atlantic

* Large, however, as is the present yield of "herring" and shad in the Potomac River it is but a mere fraction of that which prevailed less than fifty years ago. Martin's Gazetteer of Virginia and the District of Columbia, published in 1835, states that the number of fisheries on the Potomac in the previous year was 150, and that in six weeks' time 22,500,000 shad and 750,000,000 herring were taken in this river. Allowing an average of three pounds for each of the shad and three-fourths of a pound to the herring, we have the enormous aggregate of 630,000,000 pounds of food taken in a single river in six weeks' time alone, not including the immense quantity of striped bass or rock-fish, sturgeon, and other fish that doubtless belonged to the catch. These statistics, large as they appear, are corroborated by the older fishermen of the Potomac.—S. F. B.

coast abounded in shad and furnished an enormous aggregate of food, sufficient for several months' supply to the inhabitants, and allowing a surplus for shipment, either fresh or salted. Now, however, this condition has become a matter of tradition in regard to nearly every stream south of the Potomac, and nothing but artificial propagation will restore the stock. When, however, we bear in mind that the eggs of a single pair of shad, artificially treated, can be made to produce more young fish than those of two hundred pairs of natural spawners, the importance of the measures adopted by the Commission will be readily appreciated.

4.—THE SHAD.

The hatching and distribution of shad began rather late in 1874, as the appropriation for the purpose was not available early enough for work in southern rivers. In the last week of June Mr. Milner proceeded with a force of men to the hatching-station of the New York commissioners, at Coeymans Landing on the Hudson River, from which point the distribution to western waters was at once begun. Four hundred thousand shad were placed in the tributaries of the Mississippi, in the Brazos and Colorado Rivers of Texas, and the tributaries of the great lakes. On the 3d of July the traveling parties moved to South Hadley Falls, Mass., on the Connecticut River. From this station over two millions of shad were transferred to the tributaries of the Mississippi, of the great lakes, Lake Champlain, and rivers of New England. Five hundred and sixty-five thousand fry were carried above the dam and placed in the Connecticut River, for the most part above Bellows Falls, Vermont. In all, three million and thirty-one thousand young shad were planted in waters of the United States between June 25 and August 15 of 1874.

Those in charge of the transfers were very successful in transporting these fishes and in placing them, in a healthy condition, in the waters for which they were destined.

The generous action of Germany in the gift to the United States, in 1873, of 250,000 salmon-eggs prompted an attempt to transport some young shad to Germany, and the North German Lloyd Steamship Company kindly offering free passage for both men and fish to Bremen and back, the experiment was entered upon early in August. On the 5th of August Mr. Fred Mather and Mr. A. A. Anderson left by the steamer Donau, captain Neinaber, with 100,000 shad-embryos, a large and convenient compartment was assigned for them, and the cans were so arranged that the movement of the ship need not affect the shad, while an abundance of Croton water was taken on board for their use. Unfortunately, after six days the fish showed signs of distress and in ten days they were all dead.

A detailed account of the trip will be found in Mr. Mather's report. Excepting in this instance every shipment was a complete success.

Shad-hatching in 1875 was commenced April 1. The first efforts

were on the Neuse River, North Carolina. A camp was established by Mr. Milner at Kinston, in the vicinity of three fisheries, which was continued until May 10. The river was exceedingly high during the whole time. Continued fishing was not begun until April 14, when the water had lowered sufficiently for seine-hauling. The catch was very light, and no spawners were found.

On the 12th of May a camp was made near Fish-Haul, on the Pamunky River, Virginia, and some fifty thousand eggs impregnated, but the ova not thriving well the station was continued only ten days, with results of no consequence.

On the 27th of April a reconnaissance of the fisheries of the Potomac was made in the steam-tug Triana, United States Navy, Captain Cook, kindly placed at my disposal by the Secretary of the Navy. Mr. Milner directed the trip, the commissioners of Virginia and Maryland being members of the party. The results secured by this reconnaissance were an intimate knowledge of the fisheries, the selection of favorable hatching-stations, and the securing of a collection of the fishes of the river, while the good will of the fishery proprietors was sought for the purpose of facilitating the obtaining of eggs at the fisheries. A full report of the expedition will be found in the appendix.

Stations were established on the Potomac at Free-Stone Point, Va., at the Virginia end of Long Bridge, and, later, at Moxley Point, Md., and at Ferry Landing, Va. The work lasted from May 15 to June 5, and about 4,885,000 shad were released in the Potomac River. The season at the fisheries was a poor one. The protracted cold weather of the spring retarded the ripening of the ova, and the eggs did not thrive well in the cold waters after they were taken from the fish. In an ordinary season a much larger number of young shad would have been placed in the water as the result of such effort. Still this is to be considered as very fair success if compared with the hatching of 1873, which yielded only 1,370,400 shad for the Potomac, and 70,000 shipped to waters of Virginia and West Virginia.

The season having closed in the region just referred to, traveling parties proceeded to the Hudson River, arriving on the 11th of June, when the work of distribution began. Shipments were made from here to four important tributaries of the Mississippi, and to the Colorado River of Texas, of about 425,000 young shad.

On the 1st of July operations commenced at South Hadley Falls, Mass. The first shipment was started on the 7th of July, between which date and the 31st, transfers were made to waters in the Mississippi Valley, Lake Champlain, to the Atlantic Slope rivers, and the rivers of the Gulf States. As a general summary of the work at this station, it may be stated that the waters of New England other than the Connecticut River received 320,000 shad; there were carried westward and southward, 590,000; carried above the Holyoke Dam to the Upper Connecticut, 1,205,000; hatched and put in below the dam, 4,500,000; sent to Germany, 400,000. Total, about 7,000,000.

From Point Pleasant, Pa., shipments were made of about 200,000 shad, on July 8, to the headwaters of the Roanoke, in Virginia, and to the Pearl River, of Mississippi and Louisiana.

The entire number of shad hatched out during the season was over 12,500,000. The accompanying tables give the facts pertaining to their distribution. Preference was given this year to the Mississippi waters and the rivers of the Atlantic and Gulf slopes. The only shipments to the tributaries of the lakes were to those of Lake Champlain.

In reviewing the labors of the season, it may be remarked that no success was had in southern waters, the stock of fishes being greatly reduced and the hauls small, and consequently ripe male and female fish are rarely obtained at the same time. The Potomac, although the season's catch was very much diminished, afforded a larger quantity of eggs, but it would appear to be at a disadvantage when compared with the Hudson or the Connecticut for obtaining spawn.

The head of the present migration of the shad in the Connecticut is the Holyoke Dam. For a half mile below the dam, the water is shoal and runs among projecting rocks. Just below the Holyoke Bridge is a deep and wide area of the river, into which the shad congregate to spawn. This is the seining-ground, and offers probably the best facilities for obtaining shad-ova of any locality in the United States.

In the Hudson the upper spawning-ground is near Coeymans Landing, where a long projecting point shelters a large bayou or arm of the river. About twenty miles above this is the Troy dam, which, until the fish-way was erected, was an effectual obstruction to the fishes, but for some reason few shad go above Coeymans. So well recognized is this habit, that the occasional shad found above the Coeyman's spawning-ground are termed gipsies. This station of the New York commission is established at the spawning-grounds, where plenty of ripe fish are to be obtained during the season.

The Potomac has no extensive seining-ground above the end of Long Bridge. Small seines, pound-nets, and skim-nets are used to the very foot of the falls, but no hauls are made sufficiently large to warrant a hatching-station with the probability of taking ripe males and females at each haul above the Jackson City fishery. In fact, the spawning-ground does not concentrate at any one point, but is found along the river at nearly all the shad-seining grounds. This compels a multiplication of stations, and the past season eggs were obtained from Free Stone Point, Ferry Landing, and the end of Long Bridge, Virginia, and from Moxley Point, Maryland, and in fact it would be worth while to test any fishery where there was sufficient shelter for the hatching-boxes from the effect of wind and sea. The Ferry Landing fishery afforded the largest number of eggs in 1875, although the time occupied was shorter than at some of the other localities.

Hoping to favorably solve the problem as to the possibility of carrying young shad alive across the Atlantic Ocean, in which a failure was experi-

enced in 1874, a shipment was determined upon during 1875, and the preliminary experiments were first begun at Washington under the care of Mr. Fred Mather, who made the attempt the previous year. Among the apparatus devised by this gentleman was a cylinder of tin hung upon gimbals, as would be necessary at sea. Within the cylinder was a screen a few inches from the bottom. A current of water flowed through a rubber hose into an inlet in the bottom of the cylinder, and, rising through the screen, overflowed at the top. No success, however, was obtained with this contrivance, and Mr. Mather proceeded to Point Pleasant, Pa., to renew his experiments at the shad-hatching station near that point.

A new device, however, was finally hit upon, the suggestion of Mr. Charles Bell, Mr. Mather's assistant. Instead of a cylinder, a funnel-shaped vessel was made, the bottom above the inlet being guarded by a wire screen only 2 inches in diameter. The eggs were put into the funnel, and the flow of the water up through the small end lifted them toward the surface repeatedly as they fell back toward the bottom. Mr. Mather reported his experiments with this arrangement as entirely satisfactory, and recommended it for the Atlantic trip, as will be seen from his report in the appendix.

At Coeymans Landing experiments for a similar purpose were begun about June 15, by Mr. Welsher, who, before they were completed, associated with him Mr. Monroe A. Green. In these the eggs were taken soon after impregnation and put into a series of flannel screens, which were adjusted in a case in the same manner as a case of drawers. In the upper screen was a quantity of ice, the water from which dripped upon the screens below. By this process the eggs were successfully retarded about seven days, and then hatched out as vigorous fishes. Mr. Welsher having announced the success of his experiment in advance of Mr. Mather's completing his, he was called upon to take charge of the trip across the ocean.

About four hundred thousand eggs were taken and impregnated by Mr. Monroe A. Green, on the night of the 16th of July. These were all selected eggs, the lighter ones from each fish having been flowed out of the impregnating pans and only the heavier superior ones retained. The screens were filled, and the cases with a large quantity of broken ice placed in contact with them, packed in turners' shavings. The shipment started from New York on the steamer Mosel, Captain Neinaber, the 17th of July. The purpose was to carry the eggs in the cases for six or seven days, and then remove them to tin vessels devised by Mr. Green, when they were expected to hatch and the embryos to remain until deposited in the Weser. This hatching-apparatus was a tin funnel, quite similar in form to Messrs. Bell and Mather's; but, instead of the flow of water and movement of the eggs by a stream of water, air was forced in from below; the bubbles, forcing the water upward in a current diverging along the outward sloping sides of the funnel, raised

the eggs with a cloud of minute bubbles of air. Nine of these funnels were provided with rubber hose leading to an air-reservoir filled by an air force-pump. Unfortunately, however, on opening the cases after getting under way, the eggs were found to have suffered from railroad jolting, and they all rapidly died before any were hatched or even the eye-specks had begun to show.

At the end of the season at South Hadley Falls, Mass., Mr. Milner arrived at Noank, bringing with him about 45,000 shad, when experiments were carefully made in attempting to accustom shad to small proportions of sea-water. For this purpose, earthen jars with a capacity of about four gallons were used. The object in view was to ascertain the effect of a very gradual increase of sea-water. The jars received a continually-increasing proportion of sea water, until, in two of the tests, it became all sea-water. In the other two experiments, it was allowed to reach a certain proportion and so remain. Other jars were assigned for tests of the effect of different temperatures upon the fish. It was found that shad placed directly in sea-water die very rapidly, but that sea-water introduced gradually and in small proportions has not a sensibly injurious effect. The decision, however, was against its use, unless with extreme caution and in very small quantities, when it is absolutely necessary for purifying stale water. Later in the season, Mr. Chas. D. Griswold experimented with partially-grown shad taken at Holyoke, Mass. The results showed far less advantage in the transportation of the older shad; the numbers that could be carried were but a minute fraction of the large numbers of embryos usually transported, while in most instances they did not survive as long as the younger fish.

5.—CALIFORNIA SALMON.

Mr. Livingston Stone arrived at the McCloud River station and began operations August 6, 1873. A pen, or corral, was built in the river, but it was found to be too small, the fish not retaining their vigor, while a large proportion of those confined in the inclosure died. The seine was again resorted to, and sufficient salmon taken to make up the prescribed quota of 2,000,000 eggs. The hatching establishment was moved to the bank of the river, and the water raised by a bucket-wheel turned by the current.

The eggs were packed in moss in boxes two feet square by one foot deep, each containing 75,000 eggs. Two boxes were put into a crate, with a space on all sides, which was packed with hay and broken ice. When ready for shipment, there were about 2,000,000 in good condition. The first lot, 300,000, was shipped September 20, 1873; a second lot, 500,000, on the 30th; a third lot, 330,000, October 7th, and a fourth lot, 250,000, on the 14th. A fifth lot, 20,000, was placed directly into the McCloud River on the 19th of October, and 500,000 were left to hatch. The total was 1,900,000 salmon-eggs.

The consignees who received the eggs and arranged for their care in

the hatching-houses where they were carried forward until the young fish were placed in the waters, with the number of eggs to each, were as follows: J. H. Slack, Bloomsbury, N. J., 550,000; James Duffy, Marietta, Pa., 170,000; Seth Green, Rochester, N. Y., 200,000; R. G. Pike, Middletown, Conn., 150,000; Livingston Stone, Charlestown, N. H., 50,000; E. A. Brackett, Winchester, Mass., 50,000; Charles G. Atkins, Bucksport, Me., 50,000; George H. Jerome, Niles, Mich., 120,000; A. P. Rockwood, Salt Lake City, Utah, 40,000; Dr. W. A. Newell, San Francisco, Cal., 20,000. The 500,000 for the Sacramento waters were hatched at the station. Some of the cases of eggs arrived in excellent condition, while many were found to have heated and fermented, with but a small proportion of the eggs in a healthy condition. The number of fishes reported by the State commissioners as resulting from the 1,900,000 eggs was 1,522,930, the distribution of which is given in detail in the appended table.

Mr. Stone began operations at the McCloud station on the 5th of July, 1874. Modifications in the apparatus used were effected which resulted in a great improvement of the condition of the eggs. The trays in the hatching-boxes were quite deep, and the eggs put into them in twelve layers; the water rising from below in the Williamson troughs buoyed the eggs so that the lower layers did not suffer from the weight of those above them. By this means space was economized and a very large number of eggs cared for. The corral, or pen, of the previous year was also improved upon. A substantial timber grating was built across the stream somewhat in the style of that used by Professor Rasch in the fiords of Norway. Below the fence large corrals, or pens, were erected, into which the salmon were gathered and retained until their spawn was needed. The grating was an entire bar to the salmon, no opening being left to permit their passing above it; and the experiment satisfied Mr. Stone that salmon which ascend the river to spawn never return to the sea. The number which had passed above the grating before it was finished, he estimated at hundreds of thousands, while thousands crowded against its lower side when completed, vainly attempting to pass. As to their return, he failed to discover a single live salmon, though thousands of dead ones lodged against the upper side of the grating.

The work of developing the eggs to the point of hardiness requisite for their safe shipment, was continued until the 25th of September, when the first shipment was made. On the 18th of October, the sixth and last shipment was made. The whole number transmitted eastward was 4,155,000, which with 850,000 hatched at the station for California waters, make a total of 5,005,000. There were reported from these 2,908,710 fishes distributed, and 25,000 eggs remaining to be heard from. November 30, the last of the fishes was placed in the waters of the McCloud and the camp closed for the season. The details of the distribution will be found in the accompanying table.

The California salmon, believed to be the same as the *quinnat* salmon of the Columbia River (*Salmo quinnat*, Rich,) is one of the largest of this family. Its average weight in the Sacramento River is 20 pounds, while in overgrown individuals it is as high as 100 pounds. Its flavor when fresh and properly cooked is scarcely inferior to that of the Atlantic coast salmon (*Salmo salar*,) and in the markets of California and as far eastward as New York it is sought as a luxury, and commands a high price. Prepared in cans it finds a wide market throughout the United States and in Australia.* It is by far the most prolific fish on the Pacific coast. Of an anadromous habit, it swarms up the Columbia, the Sacramento, and San Joaquin Rivers in vast shoals from March to August, and thus becomes valuable not merely as an occasional article of table luxury, but as a large commercial resource. Statistics published in the weekly Astorian, Astoria, Oreg., for the season of 1875 on the Columbia River, give 13,000,000 pounds as the aggregate put up at the different canning establishments, which sold at the average wholesale rate of eleven cents per pound, making a total money value of $1,430,000. Besides the sale of the fish as food the manufacture of oil from the heads has been begun, and this season a single fishing locality produced 9,000 gallons.

Statistics procured from the books of the Central Pacific Railroad Company show that 4,079,025 pounds of salmon were shipped from points on the Sacramento and San Joaquin Rivers between November 1, 1874, and August 1, 1875. (See report of California commissioners, p. 11.)

The species has proven itself thus far to be the best adapted of the family to the methods of artificial propagation. When properly packed and kept at a sufficiently low temperature the eggs endure transportation with inconsiderable loss. Once in the hatching-troughs the loss is very small before hatching, while the young are possessed of great tenacity of life, and grow to be several months old with less loss than has been experienced with any other species; indeed, they are commended by all the fish-culturists who have had to do with them for their hardiness, activity, and good-feeding tendencies. In the mature stage they are capable of adapting themselves to a variety of conditions. They pass up the Sacramento when its waters are turbid from the great quantities of sediment washed into them by the rains and the extensive

* An item published in several of the newspapers of the United States has a tendency to excite prejudice against canned salmon as food. It appeared under the heading "Poisoned by eating canned salmon," and stated that part of a can had been partaken of by several persons who experienced no unpleasant results, but that after two days the remainder of the contents of the can which had been set aside and exposed to the air, being again eaten of by the same persons, purging and strong symptoms of poisoning resulted. The fact that such large quantities of the article are consumed throughout the country with but a single instance of any ill effects suggests the possibility of something else than the salmon as a cause for the sickness—the accidental mixture, perhaps, of some deleterious article with the salmon before it was served.

hydraulic mining operations along the banks of the river and its tributaries; they go up through the warm valley of the San Joaquin River, lying in the second hottest summer area of the United States, in large shoals, ascending the numerous side tributaries to their spawning-grounds. The hottest temperature area for the months of June, July, and August, as shown by the temperature charts for the United States, lately compiled for the Smithsonian Institution, is the region of the Gila and mouth of the Colorado Rivers in Arizona Territory. The mean for these months is 88° Fahrenheit. The valley of the San Joaquin, portions of Arizona, and the lower valley of the Rio Grande River have a mean of 84°. No other portion of the United States has so high a summer mean. During the months of August and September, 1875, temperature observations were made at the railroad bridges of the Central Pacific Railroad.* The maximum, minimum, and mean temperatures for the months of August and September were as follows:

		Maximum.	Minimum.	Mean.
		°	°	°
Upper crossing	Air	107	82	98.7
	Water at surface	84	74	79.7
	Water at bottom	83	73	78.7
Lower crossing	Air	98	73	86.9
	Water at surface	82	72	76.3
	Water at bottom	81	71	76.2

As referred to by Mr. Milner in a communication to the commissioners of fisheries at their meeting in New York, February 10, 1875, the Sacramento salmon, and especially the colony entering the San Joaquin River, spawn in latitudes farther south than any anadromous species of the genus *Salmo*.†

In the report of the commissioners of fisheries of the State of California, for the years 1874 and 1875, the following statement is made with reference to the Sacramento salmon: "Large numbers pass up the San Joaquin River for the purpose of spawning in July and August, swimming for one hundred and fifty miles through the hottest valley in the State, where the temperature of the air at noon is rarely less than 80° Fah., and often as high as 105°, and where the average temperature of the river at the bottom is 79° and at the surface 80°. The salmon of the San Joaquin appear to be of the same variety as those in the Sacramento, but average smaller in size." Leaving the bed of the San Joaquin, they ascend the tributaries, the Merced, the Stanislaus, and others, and find their spawning-grounds in the snow-fed sources of these

*A series of observations were made on the temperature of the San Joaquin River, California, through the kindness of Mr. B. B. Redding, of Sacramento, commissioner for fisheries of California.

†The trouts, *Salmo fontinalis*, Mitch., in the Appalachian range, and *Salmo pleuriticus*, Cope, of the headwaters of the Rio Grande River, extend their range to about the same latitude, 37° N., as the San Joaquin salmon.

streams. The mean temperature for the Sacramento for July, said to be of ten years' observations, is given at 74°.66.*

The temperature for the McCloud River was observed between the 6th of July and the 12th of November, 1874, at 6 a. m., 3 p. m., and 6 p. m. by Mr. Livingston Stone, the maxima, minima, and means of which will be found in the following table:

Temperature, air and water, at McCloud River hatching-station.

		Air or water.	Maximum.	Minimum.	Mean.
			°	°	°
July	24 days; 67 observations	Air	106	48	76.4
	26 days; 73 observations	Water	62	54	57
August	31 days; 87 observations	Air	97	43	70.7
	31 days; 86 observations	Water	60	52	55.9
September	27 days; 78 observations	Air	100	37.5	67.8
	27 days; 77 observations	Water	58	49	51.1
October	31 days; 88 observations	Air	96	35	56.56
	31 days; 91 observations	Water	55	42	49.8
November	12 days; 30 observations	Air	58	35	48.4
	12 days; 28 observations	Water	50	42	46.89

Observations of the temperatures of the Columbia River have been kindly furnished by the firm of the Oregon Packing Company, J. W. & N. Cook, proprietors. These were made in the months of May, June, July, and August, 1875, at 7 a. m. and 12 m. The results are shown in the following table:

	Water.	Maximum.	Minimum.	Mean.
		°	°	°
May, 22 days; 44 observations	Water	56	50	46.2
June, 26 days; 52 observations	Water	61	55	58.3
July, 27 days; 54 observations	Water	70	60	66.2
August, 12 days; 24 observations	Water	70	65	66.8

By this series of temperatures, which exhibits the maxima, minima, and means of the waters where the fish have their natural home, we are enabled to judge as to the degree of warmth they may be expected to endure when transported to new waters. The testimony as to the warmth of the San Joaquin water is the most important, reaching, as it does, a maximum of 84°, and showing a mean of nearly 80° during the two months the salmon are ascending in large numbers. But the high temperature is not the only seeming trouble they encounter. According to the observer at the San Joaquin bridge, the water was very turbid at the time it was so warm, yet the salmon, passing up in large numbers, appeared in the clear waters of the tributaries higher up in a healthy, vigorous condition.

Taking into consideration the temperature, the turbidity, the volume, the velocity, and the characters of the sources, as well as the other physical conditions of the rivers inhabited by the California salmon, it seems probable that a very large number of the rivers of the Eastern

*Proceeding of the Agassiz Institute, Sacramento, California. Annual address and report on physics, &c., of Sacramento River, by Thomas M. Logan, M. D., president, October 20, 1873.

United States are equally adapted for the production and growth of this species.

On the Atlantic slope, there are few if any rivers as turbid as the Sacramento; few which have not spring sources in the Appalachian range, and among their tributaries many rapids, pools, and eddies, in rocky and gravelly places, suitable for spawning-grounds. Of the rivers of the Gulf States, the Chattahoochee and the Alabama have their sources in the southern slopes of the Blue Ridge, among cool, spring-fed brooks. They rise among hills and rocks in a country full of large springs. The Brazos and Colorado Rivers, of Texas, have their sources among the springs of the southern hills and spurs of the Rocky Mountains, and the Guadalupe and San Antonio Rivers are fed by large springs. Most of the Texas streams are turbid, but not more so than the Sacramento or San Joaquin.

The suggestion that the salmon are not likely to find suitably cold waters after descending to the sea, the following facts show to be groundless.

The temperatures of the bottom of the Gulf of Mexico have been recorded* through a series of lines extending from the longitude of the mouth of the Mississippi to the Tortugas and Key West, Fla., and temperatures found equally as cold as those off the coast of Massachusetts and New England. As low as 34° Fahrenheit has been observed at a depth of 896 fathoms; at depths of 421, 610, and 790 fathoms, 35° and 36° were observed, while 40°, 41°, and 42° were common at from 400 to over 1,800 fathoms, and 50° to 60° between less than 100 to 400 fathoms and more.

The only peculiarity especially notable in the streams to which the California salmon belong is that they are snow-fed during most of the year. As, however, the Maine salmon, a species much more sensitive to heat than that of California, inhabits rivers not snow-fed, and moreover is kept in the Bucksport breeding-pond throughout the entire summer at a temperature of 70°, we have a sufficient guarantee that the California fish will not be affected in its transfer; indeed, the whole question is one relating to the rapidity of development of the eggs, rather than to the conditions surrounding the fish; the warmer the water the more rapid and premature the birth of the embryo.

Thus far we have left entirely out of consideration the great system of waters contributing to the Mississippi River. The main stream extends from latitude 47° 50′ to 29°, and the northernmost tributary of the Missouri as far north as 50°. Its greatest length is 2,616 miles,† from its highest source to the Gulf. From the source of the Madison Fork, the formerly-supposed head of the Missouri, (within the National Yellowstone Park,) to the Gulf, it has a length of 4,194 miles.†

* Coast Survey reports.

† See measurements in tables on page 91 of the Physics and Hydraulics of the Mississippi River. United States Engineer Bureau.

The Mississippi River, with its tributaries and subtributaries, as laid down on the larger maps of the United States, exhibits over 120,000 miles of combined lengths,* which we know falls much within the extent of waters available for food-fishes; and, were the system of the Chinese adopted, all waters would be considered down to the brooks, ponds, and even ditches.

From this an idea may be formed of the vast work to be done in making the waters of the United States afford their proper quota of the food-resources of the future.

The physical conditions of the Mississippi River in contrast with the rivers of the Atlantic coast which contain or have contained the Atlantic salmon (*Salmo salar*) are very marked. Such streams as the Saint John of New Brunswick, the Penobscot, the Kennebec, and the Androscoggin of Maine, the Merrimac of New Hampshire, and the Connecticut of Western New England are, for their greater lengths, clear and with rocky bottoms, with considerable fall, and with sources, in the longest, not more than 500 miles from the sea.

The Lower Mississippi is a turbid, alluvial stream, with a fall of less than 5 inches to the mile for eighteen hundred miles from the Gulf. The nearest source, having an elevation of 3,000 feet, is near the head of the Red River, about 1,500 miles from the delta. Fort Atkinson, Kansas, on the Arkansas River, has an elevation of 2,331 feet, 1,750 miles from the mouth of the Mississippi River.

The remoteness of the elevated cold sources of the Mississippi seems to be its most unfavorable feature when viewed as to the adaptation of salmon to its waters. The California salmon traverse the Sacramento Valley to the headwaters of the Little Sacramento and the McCloud Rivers, about four hundred miles, to the headwaters of the San Joaquin, about two hundred and fifty miles. To Fort Boise, on the Snake River, where the *Salmo quinnat* are said to have been taken from the mouth of the Columbia River, is about seven hundred miles. There is no hindrance to their ascent to the vicinity of the Shoshone Falls, one hundred and fifty miles above Fort Boise, which would increase the distance from the Pacific Ocean to about eight hundred and fifty miles. The great Shoshone Falls of the Snake River, over two hundred feet high, are of course an effectual barrier to their progress up the stream.

In the report of the commissioners of Iowa,† a correspondent writing from Elko, Nev., says: "This stream is one of the many that form the headwaters of the Columbia River, and to this point, eighteen hundred miles from its mouth, the salt-water salmon come in myriads to spawn."

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* A rough approximation made by running a chartometer on the Land-Office map, and correcting the error by comparison of lengths of seventeen rivers given in the work just referred to.

† First Report of the State Fish Commissioners of Iowa for the years 1874 and 1875. Des Moines: R. P. Clarkson, State Printer, 1876, p. 17

The large King salmon, or chowichee,* and the Red salmon, hoikoh,† are, according to Mr. Dall, taken as far up the Yukon River as Fort Yukon, fourteen hundred miles from the sea.

The shad of China, samlai (*Alosa reevesii*, Rich.,) according to Mr. Salter, extend their migrations up the Yang-tse-kiang for over a thousand miles; and, according to Dr. MacGowan, to a distance of three thousand miles from its mouth.

A specimen of a shad (*Alosa sapidissima*) was received at the National Museum from Mr. R. O. Sweeney, which was taken in the Mississippi River at Saint Paul, Minn.

From these facts we may infer that the instinct of location is probably sufficient to attract a colony of fishes as far inland as the headwaters of the longest river, whenever their home has been once established there.

The vigorous strength and the energy exhibited by the California salmon during its migrations up the Sacramento and Columbia Rivers, afford the evidence that its capacity for a long migration from the sea to its spawning-grounds, is unsurpassed by any species of fish known.

Wherever the California salmon, in the process of artificial propagation, has come under the hands of the fish-culturist, it is acknowledged, as previously mentioned, to exceed all other species, which are propagated, in hardiness, in tenacity of life, and in freedom from tendency to disease. Although it will not compare with the catfishes (*Siluridæ*) or the eels (*Anguillidæ*,) or even the suckers (*Catastomidæ*,) in retaining life out of water, yet, unlike these, it does not owe its tenacity of life to a low, sluggish action of the vital forces, that retain life when the respiration has become almost entirely impeded, but rather to the possession of an excess of vitality, and which exhibits itself in all stages from the egg to the mature fish. Mr. Charles Nordhoff, in an article on The Columbia River and Puget Sound, in Harper's New Monthly Magazine,‡ in describing the processes at the canneries, says: "A salmon bleeds like a bull." Professor Agassiz thought he found evidence in the structure of the salmon family that indicated "the highest rank in the class of fishes,"§ and refers with enthusiasm "to their admirable structure" and great vigor.‖ In addition, we have the testimony of Seth Green and other fish-culturists, that the eggs and young fishes are hardy and enduring, the latter great feeders and very rapid growers. In the ponds of different fish-culturists in the country, it is common to see a school of several thousand California salmon a year old or more, which are said to have suffered no loss whatever in

* *Oncorhynchus orientalis*, Pall. (English) King salmon; (Russian) Chowichee; Native K'hah. Alaska and its Resources. By William H. Dall, director of the scientific corps of the late Western Union Telegraph Expedition. Boston: Lee & Shepard, 1870, p. 579.

† *Oncorhynchus proteus*, Pall. (English) salmon; (Russian) hoikoh. Op. cit.

‡ No. 285, February, 1874, p. 341.

§ Lake Superior. Boston: 1850, p. 25.

‖ Op. cit., pp. 327, 328.

numbers since they were placed in the pond. In the report of the commissioners of fisheries of the State of New York for the year 1874–'75, it is said of the California salmon: "These fish will endure a much higher temperature of water, spawn at a different season, are less exacting in the circumstances necessary to their well-being." In view of these facts, as to their habits, endurance, and general vigor and energy, have we not a right to hope for ultimate success in stocking the Mississippi and other eastern rivers with this valuable species?

The stocking of a large number of rivers of the United States with this food-fish to as great an extent as the Sacramento River or even the San Joaquin, is an enterprise well worthy great effort and much pecuniary outlay, and its successful achievement will prove a blessing to the poorer classes of the country as well as another evidence of the value of science in its application to the economic industries. If, however, our anticipations are only partially realized in a moderate proportion to what we now have in the California and Oregon rivers, the labor and cost of the experiment will not have been in vain, and coming generations will have cause to thank the liberality and statesmanship of our present law-givers.

6.—ATLANTIC SALMON.

During the seasons of 1873–'74 and 1874–'75 the collection of eggs of Penobscot salmon has been conducted at Bucksport, by Mr. C. G. Atkins, in the same manner as described in the report for 1872–'73.

The fixtures and apparatus employed have undergone considerable enlargement and amendment, but the essential features of the system remain the same as at first adopted. The salmon are caught in early summer in pounds in the Penobscot River, carried alive to a small fresh-water pond, and kept there until the breeding-season, when they are caught again and manipulated.

During the first season the salmon had the range of a pond of 60 acres, and a large number escaped recapture at the spawning-season. They have since been confined in an inclosure of about 10 acres, and each year the inclosing barrier has been made more secure. In 1873 and 1874 it was a strong net, and in spite of all exertions a number of salmon each year escaped. In 1875 a fence composed of wooden racks was substituted for the net, and proved an effectual means of confining the salmon.

The means of catching the fish in the fall have been improved by the introduction of additional pounds, nets, and other apparatus, so that the waste of eggs by the fish laying them before they can be caught and manipulated is reduced to a very small amount.

In the hatching-house since the first season the troughs have been reduced to a uniform length of about 23 feet, and fitted with covers.

The use of tin boxes for packing eggs for transportation has been mostly abandoned on account of its expense. Wooden trays, 3 inches

deep and from 1 to 2 feet in length and breadth, are now employed, and make at once the most compact, convenient, and economical package with which I am acquainted. The eggs are placed in these trays in layers, alternating with layers of moss, from which they are separated by pieces of thin fabric. When filled and put together in stacks, the trays are encased in sawdust, which protects from freezing during long winter journeys. In packages of 50,000 to 100,000 they occupy about one cubic foot for 5,000 or 10,000 eggs.

The number of breeding-salmon bought and manipulated, their size, the number of eggs obtained and distributed, and the number of young salmon set free are exhibited by the following table:

Year.	Salmon bought.		Salmon recaptured at spawning season.					Eggs.		Young salmon set free.
	Number.	Average weight.	Males.	Females.	Total.	Average weight.	Average length.	Number taken.	Number distributed.	
		Pounds.				*Pounds.*	*Inches.*			
1873–'74	650	13.28	143	279	422	12.28	32.24	2,453,638	2,292,675	2,065,445
1874–'75	601	14.03	178	343	521	12.73	32.19	3,008,356	2,744,877	1,686,668
Total	1,251	.....	321	622	943	.....	.....	5,461,994	5,037,552	3,752,113

The ratio of impregnation has been about 95 per cent.

Complete success has attended the incubation of the eggs, except in the season of 1874–'75, when the eggs were all, or nearly all, affected by a deficiency of strength in the outer shell. An average success was had with those eggs that remained that season in the hatching-house at Bucksport to hatch for the State of Maine; but of those that were packed for transportation large numbers were lost *en route*, or so greatly injured that they died before hatching, or soon after. Mr. Atkins attributed this phenomenon to causes existing in the state of the water of the pond and hatching-house, which remained, through prevalence of warm, dry weather, in a low, foul state through the greater part of the spawning season. In 1873–'74 the water was renewed by copious rains, and the eggs throughout incubation were in perfect health.

In 1872 and 1873, and again in 1875, all the fish handled at the spawning season were marked with metal tags and dismissed to the river. The mode of tagging in 1872 was by affixing a stamped aluminum tag to a rubber band passing around the tail. This was a defective mode, and no results were obtained from it. In 1873 the aluminum tags were attached directly by a platinum wire to the rear margin of the first dorsal fin. A reward was offered in the following spring for the return of the marked salmon, and about twenty of them were sent in, nearly all caught in the river, and more than half of them above Bangor, 25 miles further up the river than Bucksport, where they were set at liberty, showing that instinct did not impel these liberated fish to return at once to their marine feeding-grounds. They were all poorer than when set free in the fall. In 1874 the marking was omitted, but

the offered reward was renewed in the spring of 1875, and resulted in the return of seven or eight of the marked salmon of 1873, now in prime order, weighing from 16½ to 24¼ pounds. Unfortunately the aluminum tag had fallen off, and we could not trace the individual salmon, but the wire remained to attest the date of their liberation and return. The salmon set free in autumn of 1873 in poor condition returned in good condition in 1875, and not before. Probably a much larger number of these salmon were caught that were never reported, for the wire was fine and not easily seen; indeed, two marked salmon were placed in the pond without discovering the mark till the spawning season.

The experiment has been renewed in 1875, with a change in the material, platinum being substituted for aluminum in the tag.

7.—THE WHITE-FISH.

The white-fish (*Coregonus albus*, Les.,) of the Great Lakes is a fine table-fish, and as it is produced in considerable numbers in favorable waters, some attention has been given to its propagation. In 1872, arrangements were made with Mr. N. W. Clark, of Clarkston, Mich., to hatch a half million of eggs of this fish. About the middle of February, 216,000 were shipped to San Francisco, Cal., but being left to the care of the express messenger, beyond Omaha, Nebr., they suffered from the changes of temperature incident to a car with a fire in it, and arrived in very bad condition. On March 10, another shipment of 116,000 was made, which arrived in good order. In 1873, 25,000 more were transmitted and hatched, and the young fish placed in the waters of Clear Lake, from which partly grown ones were afterward taken. In 1874 an additional 20,000 were sent by Mr. N. W. Clark, late of Northville, Mich., which were hatched at Berkeley, Cal., and put into Tulare Lake. On March 8, 1875, there were shipped to San Francisco, Cal., 100,000, and March 23, 100,000 were sent to the Lakes in the Indian Reservation at Keshena, Wis. The States bordering on the Lakes and Canada have now begun the propagation of this species, by which means they intend to keep up the stock of the Great Lakes.

8.—THE CARP OF EUROPE.

After considerable inquiry and investigation we are disposed to believe that there are varieties of the European carp of superior value, because of their table qualities, and that the idea entertained by many that the carp is a very inferior food-fish has arisen from the testimony of those who have been so unfortunate as to have eaten only those of inferior quality.

Admitting its value as a table-fish, or even that it is of average excellence, it should be considered a desirable acquisition to the waters of the United States, for it has other characteristics which render it valuable, and which are not known to be possessed by any American species, among which are its fecundity and adaptibility to the most

varied waters, from deep cool lakes and rapid streams to the merest puddles and ditches,* and to latitudes from St. Petersburg, Russia, to Italy.†

Its diet is also varied; unlike the great proportion of American food-fishes it can be sustained on vegetable matter, being expecially fond of water-cresses and similar succulent plants; it also devours worms and insect-larvæ voraciously. Heckel speaks of its fondness for sheep-dung, and of its becoming fat upon it. It has proved to be admirably well adapted to the processes of artificial culture, and throughout Europe the species has been kept in a semi-domesticated condition from time immemorial in a very large number of hatching-ponds. It becomes very tame after a time, and may be taught to eat from the hand, to come to the side of the pond the culturist desires, and to follow him along its edge.

Heckel and Kner‡ speaking of it, remark that its capability of rapid propagation, its tough constitution, and excellent table qualities have induced its abundant cultivation from a very early time. It is believed to have been introduced into Europe from temperate Asia, and has spread from the Danube over the whole of Middle and part of Southern Europe. It is said to attain to an average of from five to ten pounds and even more, according to the waters inhabited, while Dr. Rudolph Hessel states that in Lower Hungary he had seen specimens weighing thirty and forty pounds. The species is of rapid growth, and, under favorable circumstances, may be made to attain a weight of three or four pounds in three years.§

In its domesticated condition the carp has developed very many varieties, some of which are improvements in quality over the original type, while the contrary is true of others. These different forms falling into their hands, naturalists have been led to name them as different species, and later students in studying the carp in its numerous forms

* In Couch's British Fishes a quotation is made from Sir Roger North, as follows:

"Carp are sometimes fed, during the colder season, in a cellar. The fish is wrapped up in a quantity of wet moss, laid on a piece of net, and then laid into a purse, but in such manner, however, as to admit of the fish breathing; the net is then plunged into water and hung to the ceiling of the cellar. The dipping must be first repeated every three or four hours, but afterward it need be plunged into the water only once in six or seven hours. Bread soaked in milk is sometimes given him in small quantities; in a short time the fish will bear more and grow fat by this treatment. Many have been kept alive, breathing nothing but air, in this way several successive days."

A History of the Fishes of the British Islands, by Jonathan Couch, F. L. S., vol. iv, containing seventy-three colored plates, from drawings by the author. (London: Groombridge & Sons, 5 Paternoster Row. 1845. Carp, p. 4.)

† In winter they are said to bury themselves in the mud in large bodies, and to remain in a somewhat torpid condition and without food, but losing little or nothing in flesh, until the following spring.

‡ Die Süsswasserfische der östreichischen Monarchie mit Rücksicht auf die angränzenden Länder bearbeitet von Jakob Heckel * * und Dr. Rudolph Kner * * * Leipzig, Verlag von Wilhelm Engelmann, 1858, p. 57.

§ Aigner, quoted by Heckel and Kner.

have been obliged to gather long lists of synonyms, each applying to one or more of the varieties. Günther's list of synonyms embraces thirty-one binomial names, and several common names. Beginning with the *Κυπρῖνος* of Aristotle, his volume includes new ones to nearly the date of its publication.* He finds the names applied to the normal type, to "varieties of the integuments," to "varieties of form," to "monstrosities," to the "eastern [Asiatic] specimens," and to a "variety with the fins much prolonged." His material for study included European specimens from different parts of England, Holland, Hungary, Switzerland, and Russia, and Asiatic specimens from China, Formosa, Japan, and Java, all which varieties he refers to the one species, *Cyprinus carpio* L.

Another species, the Crucian carp (*Carassius vulgaris* (Nilss.) Nord.) is found in temperate Asia and Europe. This, too, has been domesticated and has developed varieties principally in the particular of form. An extensive list of names pertains to this species, also. The testimony of writers agrees rather uniformly that the Crucian carp is inferior in flavor to the common carp; still, it is cultivated in portions of Europe. Its present distribution appears to extend farther north than the common carp, as it is taken in Norway and Siberia. A variety is also found as far south as Sicily.

To add to the confusion into which the existence of so many variable forms has placed the question of species, it is known that two or more hybrids exist between the *Cyprinus carpio* and other species. The best known one is that which was identified by Heckel as *Cyprinus Kollarii*, now believed to be a cross between *Cyprinus carpio* and *Cyprinus carassius* L.; it is said to be found wherever the two species are kept under domestication. This hybrid is considered to be inferior to the common carp. Another one is the cross between *C. carpio* L. and *Carassius auratus* (L.) Bleeker, which is thought superior to the latter, though much cannot be said in its favor. In a letter received from Dr. O. Finsch, still another hybrid is referred to between *C. carpio* L. and *Cyprinus brama* L.

Among all these variations of form and external characters, differing as they do in proportions of body, in the size of the scales, in the partial or complete absence of scales, in the form of the fins, and in the combinations of the characters of two species in a hybrid, there is also a variation in their edible qualities, in their prolificness, some forms being entirely sterile, and popularly believed to be neuter in gender, and also in their hardiness and adaptability to more or less unfavorable waters.

In referring to the sterile carps, Siebold remarks that many are found in which ovaries or spermaries are never fully developed. In some they are so little developed that the generative organs are found only with the

* Catalogue of the Fishes in the British Museum, by Albert Günther, M. A., M. D., Ph. D., F. R. S., F. Z. S., etc., etc. Volume seventh, London: Printed by order of the trustees, 1868.

greatest difficulty, and they are considered by many as asexual. The sterile carp is mentioned by Aristotle. They are generally well known and can be distinguished by those accustomed to handle them. In France the sterile form is the Carp Bréhaigne and Carpeau. De Latourette states that the sterile carp has shorter and thicker lips, and that the belly in the vicinity of the anus is thin and shrunken.* The better varieties seem to be the Spiegel-karpfen, mirror carp (*Cyprinus specularis* Lacep), (*Cyprinus rex-cyprinorum* (Bloch), Cuv.,) and the naked carp (*Cyprinus nudus* Bloch) or (*Cyprinus alepidotus* Ag.) and the sterile ones. It is claimed by certain English writers that by a process of spaying or castration, which can be performed on the carp, the flavor is much improved.

The artificial propagation of the carp has been carried on successfully in Europe for a number of years. Their annual deposit of eggs, however, is so large in numbers that artificial impregnation is seldom necessary, though affording a larger percentage of increase over the natural. The spawning season in Middle Europe is May and June, though, according to Siebold, some spawn as late as August. The eggs are very adhesive, and in a state of nature are found sticking to the leaves of plants and the small twigs of brush which have fallen into or which grow under the water. The eggs are thought to develop best when only one or two inches from the surface.† The fish emerges from the egg after about twenty days, leaving the shell still attached to the plant or twig. The artificial method is to express the eggs on light frames of netting, or on baskets made by wattling a wooden frame with boughs, the milt being scattered over them as they lie adherent to the nets and the leaves. The netting frames are placed vertically in a floating box, which, in a running stream, is afforded the necessary water circulation. The basket, when covered with the impregnated eggs, is treated in like manner. The boughs of the juniper (*Juniperus*) are said to be the best for making the baskets. The pairs of ripe fish may be put into the basket and left to themselves, a piece of netting being tied over the top to prevent their escape. After the eggs have been deposited the fishes should be removed.

Among the localities in Europe where, it is stated, they are bred, the following are referred to, with, in some cases, the name of the proprietor or superintendent of the ponds:

"The naked carp (*C. nudus* Bloch) is chiefly raised in North Germany; the mirror carp (*C. rex cyprinorum* (Bloch) Cuv.) in South Germany; the scaled genuine carp in North Germany (Mecklenburg, Holstein, &c.), in Bohemia and Silesia;" *fide* Dr. O. Finsch. Casel, mirror carp, Mr. Lewin Fischhof; Geirsdorf, Silesia scaled carp; Wittengen, Hanover, Mr. Link; Hameln, Fishermeister Schieber; Liebbinchen, Brandenburg;

*See Die Süsswasserfische von Mittel-Europa bearbeitet Von C. Th. E. v. Siebold. Leipzig, Verlag von Wilhelm Engelmann, 1863.

†Report 1872-'73, p. 568.

Drobriluyk, Brandenburgh, Traugott Mende; Wittengen, Bohemia, Prince Schwarzenburg; Biddahausen, near Brunswick, naked carp, Prince of Schonnburg-Lippe; Wiesbaden, common carp, mirror carp, and gold-orfe, nassauische Fisherei, Actiengesellschaft; Nürnburg, mirror carp; Gunzenhausen, mirror carp; Lusatia, estate of Cottbus Peitz; Upper Silesia, Baron Rothschild; Brickaberg, naked carp; Heesen, Mr. Bodeman; Hochst,* near Frankfort, mirror carp, scaled carp, and gold-orfe; Oldenburg, hybrid, *C. Kollarii* Heck., Mr. Wagner.

This list might be multiplied many times.

The present distribution of the carp (*Cyprinus carpio* L.) in Europe may be given as throughout the middle latitudes of Europe, extending northward to Northern Germany and southward into Italy. The *C. carassius* L. has a more northern range into Siberia and Norway, while the variety *C. humilis* is found in Sicily.

The special advantage to be gained by the possession of the carp is in its general adaptability to all waters, and that it thrives under conditions unfavorable to many species. According to Heckel and Kner, it prefers water not too rapid and a boggy bottom.

As a fish for propagation in ponds and other sluggish waters both south and north, it is believed the carp will excel all others. In Northern Silesia, according to Mr. Von dem Borne,† on the estate of Baron von Rothschild, puddles two or three feet deep in the villages are used for raising two-year-old carps for stocking distant waters. From this resource, a single estate realized what would amount to about $55 per American acre of pond-surface.

The following is a recapitulation of the good qualities of the carp:

1. Fecundity and adaptability to the processes of artificial propagation.
2. Living largely on a vegetable diet.
3. Hardiness in all stages of growth.
4. Adaptability to conditions unfavorable to any equally palatable American fish and to very varied climates.
5. Rapid growth.
6. Harmlessness in its relations to other fishes.
7. Ability to populate waters to their greatest extent.
8. Good table qualities.

The food-fish indigenous to the United States, which has been the most widely distributed in the smaller ponds and lakes, is the large-mouthed black bass (*Micropterus nigricans* (Cuv.) Lacep.) This fish is very carnivorous, preying upon almost all species in the same waters. Even the pickerel is said to decrease rapidly when in contact with it. The necessity for fish-food is always a bar to a great increase of numbers among fishes, especially in small bodies of water. Species which feed

* Carp in ponds at Baltimore, Md., obtained here by United States Commission Fisheries.

† Circular No. 1, 1876, of the Deutsche Fisherei-Verein, see translation in appendix.

upon invertebrate and vegetable forms fill out the possible quota of the waters with their own kind, while the carnivorous species require that a large, generally the larger, proportion of the inferior species upon which they feed inhabit the waters with them. An instance of the ability of the carp to stock waters to their utmost occurred at Heidelberg, Germany, where male pikes (*Esox lucius* L.) were introduced for the purpose of reducing their numbers.

9.—AQUARIUM CAR.

During the winter of 1872–'73, Mr. Livingston Stone was employed in an investigation of the fisheries of the Sacramento River and some of the inland lakes of California. In the spring of 1873, he came East to prepare for a return to California with an aquarium-car loaded with fishes for both the inland waters and sea-coast of California—an enterprise partly under the auspices of the State commissioners of California. This car, originally built for the transportation of fruit, was furnished by the Central Pacific Railroad Company. It was fitted up with the necessary tanks, ice-chests, and beds for attendants; the supply-reservoir was arranged so as to receive water from the spouts of the railroad tanks.

The stock of fishes and invertebrates taken on board consisted of 60 black bass (*Micropterus salmoides*); 11 wall-eyed pike (*Stizostedium Americanus*); 190 yellow perch (*Perca flavescens*); 12 bullheads (*Amiurus catus*); 110 cat-fish from Raritan River, *Amiurus albidus?*); 20 tautogs (*Tautoga Americana*); 41,500 eels (*Anguilla bostoniensis*); 1,000 trout (*Salmo fontinalis*); 20,000 shad (*Alosa sapidissima*); 162 lobsters (*Homarus vulgaris*); and one barrel of oysters from Massachusetts Bay (*Ostrea virginica.*) The start was made from Charlestown, N. H., June 3, and everything resulted favorably until the 8th of June, when, by the giving way of the trestle-work of a bridge at the Elkhorn River, Nebr., the aquarium-car was precipitated into the river, the car was partially up-ended, and the tanks thrown into confusion. As the lids were floated off from the tanks, it is probable that most of the fishes escaped into the river. Many of the species, however, were well adapted to the waters of the river, but of course not the tautogs, lobsters, or oysters.

In the year following, Mr. Stone left Charlestown, N. H., on June 4, 1874, under the auspices of the commissioner of fisheries of California. He arrived at the Sacramento on the 12th of June, and at San Francisco the same day. A tabulated list of the results of this expedition will be found in the appendix.

Record of distribution of young shad made from June 25, 1874, to August 15, 1874, by United States Commission of Fish and Fisheries, under direction of James W. Milner.

Date of transfer.	Place whence taken.	Period of journey.	Number of fish.		Introduction of fish.			Transfer in charge of—
			Originally taken.	Actually planted.	Place.	Stream.	Tributary of—	
		Hours.						
June 25	Coeymans, N. Y	27	Loss scarcely perceptible.	60,000	Eagleville, Ohio	Grand River	Lake Erie	Chase and Mather.
June 26	do	28	do	60,000	Fremont, Ohio	Sandusky River	do	H. W. Welsher.
June 31	do	34	do	75,000	Logansport, Ind	Eel River	Wabash River	Mather and Vealey.
July 3	do	132	23,000	20,000	Hempstead, Tex	Brazos River		Milner, Mason, and Clark.
July 4	do	149	47,000	40,000	Austin, Tex	Colorado River		Do.
July 9	do	44	Loss imperceptible	70,000	Rockford, Ill	Rock River	Mississippi River	Welsher and Chase.
July 9	do	32½	do	75,000	Bellefontaine, Ohio	Miami River	Ohio River	Mather and Vealey.
July 15	South Hadley Falls, Mass	5	do	215,000	Bellows Falls, Vt	Connecticut River		Do.
July 27	do	5½	do	140,000	do	do		Chase and Brooks.
Aug. 1	do	5	do	120,000	do	do		Mather and Vealey.
Aug. 8	do	1	do	60,000	Smith's Ferry, Mass	do		H. J. Brooks.
Aug. 20	do	5½	do	30,000	Bellows Falls, Vt	do		Do.
July 18	do	24½	do	65,000	Monroeville, Ohio	Huron River	Lake Erie	H. W. Welsher.
July 18	do	23	do	65,000	Elyria, Ohio	Black River	do	Oren M. Chase.
July 22	do	36	do	80,000	Indianapolis, Ind	White River	Ohio River	Mason and Clark.
July 22	do	5	do	110,000	Putnam, Conn	Thames River		Mather and Vealey.
	do	8	do	20,000	Noank, Conn			Do.
July 25	do	15	do	100,000	Waterville, Me	Kennebec River		Mason and Clark.
July 28	do	23	do	100,000	Mattawamkeag, Me	Penobscot River		Welsher and Griswold.
Aug. 14	do	25	do	160,000	do	do		H. J. Brooks.
July 28	do	10	do	150,000	Vergennes, Vt	Otter Creek	Lake Champlain	Chase and Brooks.
	do	6	do	36,000	——, R. I	Blackstone River		Ellis.
July 30	do	33	do	80,000	Elkhart, Ind	Saint Joseph River	Lake Michigan	Frank N. Clark.
	do	51	do	60,000	Ottumwa, Iowa	Des Moines River	Mississippi River	Mather and Vealey.
	do	60	do	40,000	Des Moines, Iowa	do	do	Do.
July 31	do	38½	85,000	80,000	Columbus, Ind	Wabash River	Ohio River	H. J. Brooks.
Aug. 1	do	27	Loss imperceptible	80,000	Detroit, Mich	Detroit River	Lake Erie	Chase and Griswold.
Aug. 3	do	7½	do	100,000	New Milford, Conn	Housatonic River		Frank N. Clark.
Aug. 5	do	60	do	100,000	Saint Paul, Minn	Mississippi River		Chase and Vealey.
Aug. 6	do	31½	do	80,000	Corunna, Mich	Shiawassee River	Lake Huron	Frank N. Clark.
Aug. 10	do	2	do	80,000	Westfield, Mass	Westfield River	Connecticut River	Charles D. Griswold.
Aug. 13	do	24	do	210,000	do	do	do	Frederick A. Smith.
Aug. 11	do	11	do	120,000	Winooski, Vt	Winooski River	Lake Champlain	Brooks and Griswold.
Aug. 12	do	12½	do	80,000	Georgia, Vt	Lamoille River	do	Do.
	do	12	do	80,000	Swanton, Vt	Missisquoi River	do	Do.
Aug. 15	do	8½	do	50,000	Noank, Conn			Charles D. Griswold.
				3,031,000				

Record of hatching and distribution of shad (Alosa sapidissima) made from May 15, 1875, to July 31, 1875, by United States Commission of Fish and Fisheries, under direction of James W. Milner.

State.	Date of transfer.	Obtained from—	Place whence taken.	Number of fish actually planted.	Introduction of fish.			Transfer in charge of—
					Place.	Stream.	Tributary of—	
Connecticut	July 9	U. S. Commission	South Hadley Falls, Mass	100,000	Canterbury, Conn	Quinnobang River	Thames River	H. E. Quinn.
Georgia	July 22		do	60,000	Rome, Ga	Coosa River	Alabama River	Clark and Quinn.
Illinois	July 31	U. S. Commission	do	60,000	Rockford, Ill	Rock River	Mississippi River	Chase and Ingalls.
Indiana	June 13	N. Y. commission	Coeymans Landing, N. Y	100,000	Indianapolis, Ind	White River	Wabash River	F. N. Clark.
Iowa	June 27		do	90,000	Des Moines, Iowa	Des Moines River	Mississippi River	Clark and Quinn.
Louisiana	July 29	U. S. Commission	South Hadley Falls, Mass	60,000	Tickfaw, La	Notalbany River	Lake Pontchartrain	Mather and Bell.
Maine	July 12	do	do	100,000	Mattawamkeag, Me	Mattawamkeag River.	Penobscot River	Quinn and Griswold.
Maryland	May 26 to June 27.	do	Moxley Point, Md	1,182,500	Moxley Point, Md	Potomac River		J. Mason.
Massachusetts	July 8, 13, and 16.	do	South Hadley Falls, Mass	725,000	Smith's Ferry, Mass	Connecticut River		Mason and Quinn.
Do	July 7 to 31	do	do	4,500,000	South Hadley Falls, Mass.	do		Charles C. Smith.
Mississippi	July 16	N. J. commission	Point Pleasant, Pa	100,000	Jackson, Miss	Pearl River		Anderson and Schwartz.
Ohio	June 15	N. Y. commission	Coeymans Landing, N. Y	75,000	Columbus, Ohio	Scioto River	Ohio River	Mason and Ingalls.
Do	June 23	do	do	100,000	Bayard, Ohio	Muskingum River	do	Clark.
Rhode Island	July 23	U. S. Commission	South Hadley Falls, Mass	8,300		Warren River		J. Mason and others.
Do	July 23	do	do	13,800		Pawcatuck River		Do.
Do	July 23	do	do	23,300		Pawtuxet River		Do.
Do	July 23	do	do	5,600		Barrington River		Do.
South Carolina	July 10	do	do	80,000	Gaffney's Station, S. C	Broad River	Santee River	Clark and Quinn.
Tennessee	July 10	do	do	80,000	Nashville, Tenn	Cumberland River	Ohio River	Chase and Boehme.
Do	July 16	do	do	80,000	do	do	do	Do.
Do	July 16	do	do	100,000	Knoxville, Tenn	Tennessee River	do	Mason and Ingalls.
Texas	July 4	N. Y. commission	Coeymans Landing, N. Y	60,000	Austin, Tex	Colorado River		Mason and Marks.
Vermont	July 22	U. S. Commission	South Hadley Falls, Mass	70,000	Georgia, Vt	Lamoille River	Lake Champlain	O. M. Chase.
Do	July 7 and 17	do	do	480,000	South Vernon, Vt	Connecticut River		Griswold and Quinn.
Virginia	May 15 to 25	do	Free Stone Point, Va	1,156,750	Free Stone Point, Va	Potomac River		J. Mason.
Do	May 18 to June 5.	do	Washington, D. C	1,072,800	Jackson City, Va	do		H. W. Welsher.
Do	May 2 to 29	do	Ferry Landing, Va	1,473,300	Ferry Landing, Va	do		Do.
Do	July 8	N. J. commission	Point Pleasant, Pa	100,000	Stanton River Station, Va.	Stanton River	Roanoke River	Anderson and Bell.
				12,055,550				

Table of California salmon transported to new waters in the United States in 1874-'75.

States.	Where finally hatched.	Waters stocked.	Tributaries in which fish were placed.	Locality.	Date of transfer.	Number of fish.	Remarks.
California	McCloud River Station, United States.	Sacramento River	McCloud River		October and Nov., 1874	850,000	Report of Commissioner of Fisheries, California, 1874-'75, p. 16.
Colorado	Georgetown, Colo		Green Lake	Georgetown, Colo	—, —, 1874	22,900	Livingston Stone's tables (MSS.)
	do		Clear Lake	do	—, —, 1874	(*)	
Connecticut	North Branford, Conn	Connecticut River	Coenochogue River	Durham, Conn	Dec. 30, 1874	50,000	Conn. Rep. Com. Fish., 1875, p. 16.
	do	Thames River	Shetucket River		Dec. 26, 1874	50,000	Do.
	do	Long Island Sound	Farm River	New Haven, Conn	Jan. 20, 1875	20,000	Do.
	Trout Association, Westport, Conn.	Housatonic River	Butter Creek	New Milford, Conn	Dec. 18, 1874	50,000	Do.
	do	Connecticut River	Farmington River	Pine Meadow, Conn	Dec. 21, 1874	50,000	Do.
	do	do	do	do	Dec. 23, 1874	20,000	Do.
	New York State hatching-house.	Long Island Sound	Quinnepiac River	—, Conn	Dec. 18, 1874	5,000	N.Y. Rep. Com. Fish., 1875, (MSS.)
Illinois	Michigan State hatching-house.	Mississippi River	Fox River	Elgin, Ill	Dec. 19, 1874	20,000	Letter of C.H. Jerome, Apr. 16, '76.
	Northville, Mich	do	Rock River	Rockford, Ill	Dec. 22, 1874	15,000	Letter of W. D. E. Andrus, Dec. 23, 1874.
Indiana	Michigan State hatch'g-house	Wabash River	White River	Indianapolis, Ind	Dec. 16, 1874	16,000	Letter of C.H. Jerome, Apr. 16, '76.
	do	Ohio River	Tanner's Creek	Guilford, Ind	Dec. 24, 1874	16,000	Do.
Iowa	Anamosa, Iowa	Mississippi River	Upper Iowa River	Fredericksburgh, Iowa	Dec. 15, 1874	300	B. F. Shaw's tables (MSS.)
	do	do	do	Decorah, Iowa	Mar. 10, 1875	8,000	Do.
	do	do	Tributary	Waukon, Iowa	Jan. 4, 1875	700	Do.
	do	do	Bloody Run	McGregor, Iowa	Dec. 15, 1874	5,700	Do.
	do	do	Turkey River, Volga River.	Greeley, Iowa	Jan. 6, 1875	600	Do.
	do	do	Turkey River	Clermont, Iowa	Jan. 27, 1875	(†)	Do.
	do	do	do	Maynard, Iowa	Jan. 27, 1875	(†)	Do.
	do	do	Turkey River, Volga River.	Fayette, Iowa	Jan. 6, 1875	14,000	Do.
	do	do	Tributary	Clinton Junction, Iowa	Dec. 27, 1874	(‡)	Do.
	do	do	Little Maquoketa River.	Farley, Iowa	Dec. 15, 1874	2,500	Do.
	do	do	do	Epworth, Iowa	Dec. 15, 1874	3,500	Do.
	do	do	Maquoketa River	Monticello, Iowa	Dec. 8, 1874	7,000	Do.
	do	do	do	Maquoketa, Iowa	Dec. 11, 1874	7,000	Do.
	do	do	do	Charlotte, Iowa	Dec. 27, 1874	5,000	Do.
	do	do	do	Worthington, Iowa	Jan. 4, 1875	2,000	Do.
	do	do	do	Delhi, Iowa	Jan. 6, 1875	400	Do.
	do	do	do	Hopkinton, Iowa	Jan. 6, 1875	400	Do.
	do	do	Maquoketa River	Manchester, Iowa	Feb. 1, 1875	200	Do.
	do	do	Maquoketa River, Spring Creek.	Delaware, Iowa	Jan. 6, 1875	4,600	Do.
	do	do	Wapsipinecon River	Anamosa, Iowa	Dec. 28, 1874 Jan. 18, 1875 Apr. 7, 1875	16,000	Do.

	....do	....do	....do	Oxford, Iowa	Jan. 18, 1875	§21,000	Do.
	....do	....do	....do	Independence, Iowa	Jan. 27, 1875	(†)	Do.
	....do	....do	Wapsipinecon River	Dixon, Iowa	Dec. 28, 1874	‖5,000	Do.
	....do	....do	Big Rock Creek	Big Rock, Iowa	Dec. 28, 1874	(‖)	Do.
	....do	....do	....do	Walker, Iowa	Jan. 27, 1875	(†)	Do.
	....do	....do	Iowa River, Cedar River.	Cedar Rapids, Iowa	Dec. 12, 1874	12,000	Do.
	....do	....do	....do	Waterloo, Iowa	Dec. 5, 1874	3,300	Do.
	....do	....do	....do	Tipton, Iowa	Dec. 18, 1874 Feb. 13, 1875	8,100	Do.
	....do	....do	....do	Marion, Iowa	Dec. 12, 1874	3,000	Do.
	....do	....do	....do	Wilton, Iowa	Jan. 18, 1875	(§)	Do.
	....do	....do	....do	Springville, Iowa	Jan. 27, 1875	†21,000	Do.
	....do	....do	Iowa River	Iowa Falls, Iowa	Dec. 18, 1874	10,000	Do.
	....do	....do	....do	Iowa City, Iowa	Jan. 18, 1875	(§)	Do.
	....do	....do		Storm Spring, Iowa	Mar. 6, 1875	4,000	Do.
	....do	....do	Des Moines River	Des Moines, Iowa	Dec. 2, 1874 Jan. 12, 1875	10,400	Do.
	....do	....do	....do	Ottumwa, Iowa	Jan. 11, 1875	11,000	Do.
	....do	....do	....do	Fort Dodge, Iowa	Dec. 18, 1874	15,000	Do.
	....do	....dd	Des Moines River, Boon River.	Webster City, Iowa	Feb. 1, 1875	9,500	Do.
	....do	....do	Des Moines River, Twin Lakes.	Pomeroy, Iowa	Feb. 1, 1875	10,000	Do.
	....do	....do	Des Moines River, Storm Lake.	Storm Lake, Iowa	Feb. 1, 1875	10,000	Do.
	....do	....do	Brown's Creek		Jan. 12, 1875	500	Do.
	....do	....do	Des Moines River, Coon River.		Jan. 12, 1875	500	Do.
	....do	Missouri River	NishnabottomyRiver	Atlantic, Iowa	Jan. 5, 1875	6,000	Do.
	....do	....do	Little Sioux River	Cherokee, Iowa	Feb. 1, 1875	10,000	Do.
	....do	....do	Floyd River	Lamar's, Iowa	Feb. 1, 1875	5,000	Do.
	....do	....do	....do	Sioux City, Iowa	Feb. 1, 1875	5,000	Do.
Louisiana	Pokagon, Mich	Lake Pontchartrain	Tangipahoa River		Jan. 1, 1875	15,000	Letter of J. E. Leet, Jan. 2, 1875.
Maine	Bucksport, Me	Penobscot River	Craig's Pond	Bucksport, Me	1875	30,000	Maine Report Commissioners of Fisheries, 1875, p. 6.
Maryland	Green Springs, Md	Susquehanna River	Octorora Creek	Liberty Grove, Md	Dec. 5, 1874	10,000	Maryland Report of Commissioners, Jan. 1, 1876, p. 81.
	....do	....do	Deer Creek	Pennsylvania line	Dec. 15, 1874	6,000	Do.
	....do	Gunpowder River	Gunpowder River	Freeland, &c., Md	Nov. 30, 1874	10,000	Do.
	....do	Patapsco River	North Patapsco River.	Tank Station, Western Maryland Railroad.	Nov. 30, 1874	6,000	Do.
	....do	....do	Patapsco River	Hood's Mills, Md	Dec. 5, 1874	6,000	Do.
	....do	Patuxent River	Branches	Howard County, Md	Dec. 9, 1874	8,000	Do.
	....do	....do		Near source	Dec. 15, 1874	10,000	Do.

*The 22,900 was divided between Green Lake and Clear Lake.
†All distributions marked with the † are included in the 21,000 marked to Springville; the number was not deposited at that point, but divided among the other places as well.
‡The 5,000 marked to Charlotte was divided with Clinton Junction.
§The 21,000 marked to Oxford was divided with the other places having the (§.)
‖The 5,000 marked to Dixon was divided with Big Rock.

Table of California salmon transported to new waters in the United States in 1874-'75—Continued.

States.	Where finally hatched.	Waters stocked.	Tributaries in which fish were placed.	Locality.	Date of transfer.	Number of fish.	Remarks.
Maryland	Green Springs, Md	Monocacy River	Pipe Creek	Wakefield, Md	Nov. 25, 1874	1,500	Maryland Report of Commissioners, Jan. 1, 1876, p. 81.
	do	do	do	Union Bridge, Md	Nov. 25, 1874	1,000	Do.
	do	do	Owens Creek	Slabtown, Md	Nov. 25, 1874	1,500	Do.
	do	do	do	Mechanicstown, Md	Dec. 2, 1874	6,000	Do.
	do	do	Bush Creek	Monrovia, Md	Dec. 5, 1875	4,000	Do.
	do	Potomac River	Antietam Creek	Hagerstown, Md	Nov. 25, 1874	3,000	Do.
	do	do	Conocochegue River	do	Dec. 2, 1874	10,000	Do.
	do	do	Evitts Creek	Tannery, Md	Dec. 2, 1874	5,000	Do.
	do	do	Wills Creek	Jennings Run, Md	Dec. 2, 1874	5,000	Do.
	do	do	Savage Creek	Frankville, Md	Dec. 3, 1874	15,000	Do.
	do	do	North Fork	Fort Pendleton, Md	Dec. 9, 1874	15,000	Do.
	do	Rivers		Eastern Shore, Md	Dec. 1, 1874	6,000	Do.
Massachusetts	Winchester, Mass	Mystic River			1874 and 1875	7,000	Stone's tables, MSS.
Michigan	Pokagon, Mich	Lake Huron	Au Sable River	Grayling, Mich	Dec. 23, 1874	50,000	Letter of G. H. Jerome, Apr. 16, '76.
	do	Lake Erie	River Raisin		Mar 22, 1875	10,000	Do.
	do	Lake Michigan	Saint Joseph River (Dowagiac River).		Dec. 17, 1874	10,000	Do.
	do	do	do		Dec. 24, 1874	10,000	Do.
	do	do	do		Jan. 15, 1875	7,000	Do.
	do	do	do	Pokagon, Mich	Jan. 16, 1875	7,000	Do.
	do	do	Kalamazoo River		Dec. 26, 1874	40,000	Do.
	do	do	Kalamazoo River (Baptist College Pond).	Kalamazoo, Mich	July 3, 1875	100	Do.
	do	do	Manistee River (Hersey River).		Dec. 18, 1874	50,000	Do.
	do		Metcalf Lake		Dec. 23, 1874	8,000	Do.
	do		Crystal Springs Creek.		Jan. 16, 1875	6,000	Do.
	do		Goguac Lake		Jan. 16, 1875	2,500	Do.
	do		Private ponds of J. C. Hyde.		Feb. 27, 1875	5 0	Do.
	do		Orion Lake		Mar. 29, 1875	10,000	Do.
	do	Lake Superior	Carp River		Dec. 30, 1874	60,000	Do.
Minnesota	Hon. E. Rice, Saint Paul, Minn.; Watkins & Bogart, Red Wing, Minn.; and Stillwater Trout-Brook Company.	Red River		Breckinridge, Minn	May, 1875	500	Minnesota Report Commissioners of Fisheries, 1875, pp. 9, 10.
	do	Lake Superior	Saint Louis River, Twin Lakes.	Pine County, Minn	May, 1875	500	Do.
	do	Mississippi River	Saint Louis River, Big Lake.	do	May, 1875	500	Do.

	....do....	....do....	Saint Croix River...	Chisago County, Minn.	May, 1875	5,000	Do.
	....do....	....do....	Saint Croix River, several lakes.	....do....	May, 1875	12,800	Do.
	....do....	....do....	Saint Croix River, White Bear Lake.	Ramsey County, Minn	May, 1875	300	Do.
	....do....	....do....	Saint Croix River, Bass Lake.	....do....	May, 1875	100	Do.
	....do....	....do....	Saint Croix River, Lake Como.	....do....	May, 1875	100	Do.
	....do....	....do....	Saint Croix River, Lake Johanna.	....do....	May, 1875	100	Do.
	....do....	....do....	Cannon River.....	Owatonna, Minn.....	May, 1875	1,000	Do.
	....do....	....do....	Minnesota River, Cedar Lake.	Rice County, Minn ...	May, 1875	1,000	Do.
	....do....	....do....	Minnesota River, Minnesota Lake.	Faribault County, Minn.	May, 1875	1,000	Do.
	....do....	....do....	Farmington River..	Dakota County, Minn.	May, 1875	1,000	Do.
	....do....	....do....	Iowa River, Cedar River, Lake Albert Lea.	Freeborn County, Minn.	May, 1875	1,000	Do.
	....do....	....do....	Iowa River, Cedar River.	Mower County, Minn	May, 1875	300	Do.
	....do....	....do....	Lake Minnetonka...	Hennepin Cou'y, Minn	May, 1875	500	Do.
New Jersey.....	Bloomsbury, N. J.....	Delaware River....	Tributaries.....	.....	1874, 1875....	160,000	New Jersey Report of Commissioners of Fisheries, 1875, p. 19.
	....do....	Passaic River.....	....do.....	.....	1874, 1875...	2,000	Do.
	....do....	Raritan River.....	....do.....	.....	1874, 1875....	3,000	Do.
New York.....	State hatching-house.....	Lake Ontario.....	Oswego River.....	Skaneateles Lake.....	Dec. 9, 1874	21,000	Seth Green's tables, (MSS.)
	....do.....	....do.....	....do.....	....do.....	Mar. 2, 1875	3,000	Do.
	....do.....	....do.....	Oswego River, Fish Creek.	.....	Dec. 10, 1874	20,000	Do.
	....do.....	....do.....	Oswego River.....	Fulton, N. Y.....	Dec. 11, 1874	2,000	Do.
	....do.....	....do.....	Oswego River, Oneida Lake.	.....	Dec. 18, 1874	20,000	Do.
	....do.....	....do.....	Genesee River, Caledonia Creek.	Caledonia, N. Y.....	Dec. 15, 1874 Dec. 22, 1874 Jan. 26, 1875 Mar. 2, 1875	27,010	Do.
	....do.....	....do.....	Genesee River, Conesus Lake.	Livingston Co., N. Y..	Jan. 2, 1875	10,000	Do.
	....do.....	....do.....	Genesee River, Allen Creek.	.....	Dec. 15, 1874 Mar. 15, 1875	50,000	Do.
	....do.....	....do.....	Oak Orchard Creek.	Orleans County, N. Y.	Dec. 17, 1874	30,000	Do.
	....do.....	....do.....	Sandy Creek.....	....do.....	Dec. 25, 1874	10,000	Do.
	....do.....	....do.....	Salmon River, Beaver Creek.	Sand Bank, N. Y.....	Dec. 30, 1874	10,000	Do.
	....do.....	Hudson River.....	Fortville, Peatwig, and Ingelsby C'ks	Fort Edward, N. Y....	Dec. 21, 1874	45,000	Do.
	....do.....	....do.....	Mohawk River.....	.....	Dec. 30, 1874 Jan. 11, 1875	47,000	Do.
	....do.....	....do.....	Mohawk River, Sequoit Creek.	Oneida County, N. Y..	Jan. 9, 1875	8,000	Do.

Table of California salmon transported to new waters in the United States in 1874-'75—Continued.

States.	Where finally hatched.	Waters stocked.	Tributaries in which fish were placed.	Locality.	Date of transfer.	Number of fish.	Remarks.
New York	State hatching-house	Allegheny River	Chautauqua Lake	Chautauqua Co., N. Y.	Feb. 24, 1875	1,000	Seth Green's tables, (MSS.)
Ohio	New York State hatching-house.	Lake Erie	Grand River	Eagleville, Ohio	Dec. 9, 1874	10,000	Do.
	Northville, Mich	do	Huron River	Monroeville, Ohio	1874	10,000	Letter of ——
Pennsylvania	Marietta, Pa., and Bloomsbury, N. J.	Susquehanna River	Swatara Creek		Dec. 22, 1874	30,000	Pennsylvania Report Commissioners, 1874, p. 14.
	do	do	Yellow Breeches		Dec. 26, 1874	30,000	Do.
	do	do	Pine Creek		Jan. 5, 1875	15,000	Do.
	Bloomsbury, N. J	do	Connadaquinnat Riv		Dec. 6, 1874	6,000	Do.
	Marietta, Pa	do	Buffalo Creek		Jan. 5, 1875	10,000	Do.
	do	Delaware River	Bushkill Creek	Easton, Pa	Dec. 21, 1874	60,000	Do.
	do	do	Tributaries		1875	111,000	Stone's tables, (MSS.)
	do		Aquatong Lake		1875	30,000	Do.
Rhode Island	Ponaganset, R. I	Blackstone River			1874, 1875	12,000	Do.
	do	Pawtuxent River				35,000	Do.
	do	Pawcatuck River				20,000	Do.
	do	do	Artificial ponds			1,000	Do.
Texas	Niles, Mich	Brazos River		Hempstead, Tex	Dec. 11, 1874	2,000	Letter of G. H. Jerome, April 16, 1876.
	do	Colorado River		Austin, Tex	Dec. 12, 1874	12,000	Do.
Utah	Jordan, Utah	Salt Lake	Jordan River	Jordan, Utah	Sept. 29, 1874	195,000	Letter of A. P. Rockwood.
Virginia	do	James River			Nov., 1874	5,000	Letter of W. B. Robertson, December 23, 1874.
	Bloomsbury, N. J	Roanoke River		Salem, Va	Dec. 22, 1874	5,000	Letter ——
	do	Rappahannock River				Unknown	
	do	New River			Dec. 22, 1874	10,000	Report J. H. Slack, (in present volume.)
	do	Potomac River	Cedar Creek	Winchester, Va	Jan., 1874	30,000	Maryland Report Commissioners Fisheries, Jan. 1, 1876, p. 81.
	do	do	South Fork	Romney, Va	Dec. 9, 1874	15,000	Do.
Wisconsin River.	Boscobel, Wis	Mississippi River	Green Lake		Dec., 1874	10,000	Stone's tables, (MSS.)
	do	do	Tributaries			22,000	Do.
Canada*	do	Lake Ontario		Newcastle, Ontario	1874, 1875		
New Zealand*							
Total						3,077,310	
Distribution outside of United States not reported						50,000	
Grand total						3,127,310	

* A shipment of 25,000 eggs to the government hatching-house of Canada; and a shipment of 25,000 was made by Mr. W. A. Newell to New Zealand.

Table of Penobscot salmon (Salmo salar) transported to new waters in the United States in 1874 and 1875.

States.	Where finally hatched.	By whom hatched.	Waters stocked.	Tributaries in which fish were placed.	Locality.	Number of fish.	Date.
California			Sacramento River		Redding, Cal	305	1874
Connecticut	Westport, Conn	E. M. Lees	Connecticut River, Conn	Farmington River	New Hartford, Conn	65,000	1875
Illinois	Pokagon, Mich	G. H. Jerome	Calumet River		Kensington, Ill	25,000	1874
	Elgin, Ill	W. A. Pratt	Illinois River	Fox River	Elgin, Ill	19,000	1875
Iowa	Anamosa, Iowa	B. F. Shaw	Mississippi River	Dubuque Creek	Dubuque	3,000	1875
	do	do	do	Cedar River	Cedar Rapids	4,000	1875
	do	do	do		Waverly	25,000	1875
	do	do	do	Turkey River	West Union	15,000	1875
	do	do	do	Iowa River	Marshall	5,000	1875
	do	do	do	Maquoketa River	Manchester	2,000	1875
	do	do	do		Worthington	2,000	1875
	do	do	do	Bear Creek	Bear Creek	4,000	1875
	do	do	Missouri River		Council Bluffs	10,000	1875
Maine	Bucksport, Me	C. G. Atkins	Penobscot River	Mattawamkeag River	Eaton and Danforth	45,000	1874
	do	do	do	Salmon Stream		25,000	1874
	do	do	do	Tributary of Baskachegan		5,000	1874
	do	do	do	Passadumkeag River		10,000	1874
	do	do	do	Seboois Stream	Whitney Ridge	25,000	1874
	do	do	do	do	Howland	25,000	1874
	do	do	do	Piscataquis River	Milo	15,000	1874
	do	do	do	Pleasant River	Brownville	15,000	1874
	Sebec Lake	H. L. Leonard	do	Piscataquis River	Dover	25,000	1874
	do	do	do	Sebec Lake	Ship Pond Stream	20,000	1874
	Dobsis Stream	G. L. F. Ball	Saint Croix River	Schoodic Lakes	Dobsis Stream	10,000	1874
	Pembroke, Me	J. N. Whitman	Penmaquan River			8,613	1874
	Bucksport, Me	C. G. Atkins	Penobscot River	Seboois River	Howland	30,000	1875
	do	do	do	Madaceunk Stream		15,000	1875
	do	do	do	Salmon Stream		5,000	1875
	do	do	do	Mattawamkeag River	Bancroft	20,000	1875
	do	do	do		Danforth	45,000	1875
	do	do	do		Kingman	94,000	1875
Maryland	Green Spring, Md	Alex. Kent	Unknown	Unknown		Unknown	1875
Massachusetts	Westbrook, Conn	E. M. Lees	Red Brook	Quobaug	Palmer, Mass	30,000	1874
Michigan	Pokagon, Mich	George H. Jerome	Lake Huron	Au Sable River	Wildwood	8,000	1874
	do	do	do		South Lawn	7,000	1874
	do	do	Manistee River	Pine River		40,000	1874
	do	do	Boardman River	Salmon Creek		40,000	1874
	do	do	Muskegon River	Higgins Lake	Roscommon County, Mich	7,000	1874
	do	do	Saint Mary's River			25,000	1874
	do	do	Saint Joseph's River	Dowagiac River		5,000	1875
Minnesota	Red Wing, Minn	Watkins & Bogart	Unknown	Unknown		18,600	1875
New Hampshire	Concord, N. H	W. W. Fletcher	Connecticut River	Headwaters	Sundry places	50,000	1874
	Charlestown, N. H	L. Stone	do	Connecticut River	Charlestown	15,000	1874
	Winchester, Mass	E. A. Brackett	do	Headwaters and tributaries	Sundry places	97,000	1874

Table of Penobscot salmon (Salmo salar) transported to new waters in the United States—Continued.

States.	Where finally hatched.	By whom hatched.	Waters stocked.	Tributaries in which fish were placed.	Locality.	Number of fish.	Date.
New Hampshire	Winchester, Mass	E. A. Brackett	Merrimac River	Pemigewassett River	Near Plymouth, N. H	30,000	1875
	do	do	do	Contoocook River		30,000	1875
New Jersey	Bloomsbury, N. J	J. H. Slack	Delaware River			12,000	1874
	do	do	do	Musconetcong River		65,000	1874
	do	do	Raritan River			31,000	1874
	do	do	Hackensack River			10,000	1874
	do	do	Passaic River			50,000	1874
	do	Mrs. Slack	do	Whippang River	Morristown, N. J	1,000	1875
	do	do	do	Rockaway River	Dover, N. J	1,000	1875
	do	do	Raritan River	South Branch	South Branch	3,000	1875
	do	do	Delaware River	Paulinskill, Pohatcong, Musconetcong.		74,000	1875
New York	Caledonia, N. Y	Seth Green	Lake Ontario	Allen's Creek		10,000	1875
	do	do	Hudson River	Mohawk River	Rome, N. Y	20,000	1875
	Charlestown, N. H	Stone & Hooper	do	Saranac River	West Plattsburgh, N. Y	36,500	1875
	do	do	do	Salmon River	Peru, N. Y	10,000	1875
	do	do	do	Chazy River	Ellenburgh, N. Y	48,500	1875
	Marietta, Pa	J. P. Creveling	Delaware River	Bushkill Creek	Northampton County	55,000	1874
	do	do	Susquehanna River	Swatara Creek	Dauphin County	30,000	1874
	do	do	do	Chiques Salunga Creek		25,000	1874
	do	do	do	Donegal Creek		12,000	1874
Rhode Island	Poneganset, R. I	J. H. Barden	Blackstone River	Slatersville Branch	14 places	4,000	1874
	do	do	Pawcatuck River		18 places	15,000	1874
	do	do	Pawtuxet River		98 places	40,000	1874
	do	do	Blackstone River	Slatersville Branch	10 places	15,000	1875
Vermont	Westport, Conn	E. M. Reeves	Connecticut River	Passumpsic tributaries	Wheelock, Vt	10,000	1874
	do	do	do		Concord, Vt	5,000	1874
	do	do	do		Barnet, Vt	30,000	1874
	do	do	do		McIndoe's Falls, Vt	25,000	1874
	do	do	do	Wells River		25,000	1874
	do	do	do		Newbury, Vt	25,000	1874
	do	do	do	Saxton River	Rockingham, Vt	5,000	1874
	Charlestown, N. H	L. Stone	do	White River	Royalton, Vt	15,000	1874
	do	do	do	Lamoille River	Georgia, Vt	70,000	1874
	do	do	do	Dog River	Northfield, Vt	12,000	1874
	do	Stone & Hooper	Lake Champlain	Lewis Creek	Ferrisburgh, Vt	24,000	1875
	do	do	Hudson River	Battenkill Creek	Manchester, Vt	47,500	.....
Wisconsin	Waterville, Wis	H. F. Dousmann	Rock River	Madison Lake		7,500	1874
	do	do	Illinois River	Geneva Lake		,500	1874
	Boscobel, Wis	A. Palmer	do	Elkhart, Cedar Rock, and Devil's Lakes.		Unknown.	1875
Total						2,294,365	