(editor's note: This paper was transcribed from a handwritten cursive copy with various difficulties. For a perfect rendition, the reader might wish to consult the original, itself a copy, in the volume entitled *Literary Club Papers 1*, 1885 – 1886 Oct 3, '85 to May 29, '86) The original is very badly faded. Note also that hand-written marginal notes have been moved into the text.

The United States Fish Commission

All of the early writers about this country refer to the great abundance of good fishes, which, in former times thronged our coast. Compared with the present supply, their accounts seem like Munchausen's tales.

All the accounts agree that the food fishes existed upon our coast in early times in almost miraculous numbers. One writer, in his statement written in 1630 says, "The abundance of Sea Fish are almost beyond believing; and sure I should scarce have believed it except I had seen it with mine own eyes."

It was not until about 1851, that means, other than hook and line, were used to capture the food-fishes, and then capture gave employment to thousands of men, and furnished a cheap and wholesome food to the inhabitants of the sea coast. The supply exceeded the demand. When, however, the railroads began to provide quicker and cheaper means of transfer, and ice began to be used to prevent or retard decomposition, and the market was opened for them in a fresh condition, in the interior of the country, and when they came to be used more extensively to fertilize the land, wholesale methods of capture were devised, to supply the demand. Then traps, pounds, purse-seines, gill-nets, and other devices were employed, and increased in numbers and efficiency, each year. The hook and line fisherman caught fewer and fewer, and soon abandoned that way of catching fish.

Let me call your attention to a pound net. Its success depends upon the fatal principle of fish, never to turn a sharp corner. A place is chosen where it is known that large shoals are accustomed to coast along parallel with the shore, and then a barrier is run out in a straight line. This barrier is called a leader, and may be a stone wall, a fence of laths, or of brush, or a net stretched on poles. At the end of this leader, and like a spearhead on its handle, is constructed a heart shaped enclosure, having a narrow opening on either side next to the point of the leader at its off-shore end. This heart again opens into a circular enclosure, called the bowl or pound. A shoal of fish, coasting near the shore is suddenly stopped by the leader, and immediately the fish turned towards deep water, and, swimming parallel

with the barrier pass into the heart from whence there is no escape save by a sharp, backward turn, which, as before stated, is against their principles; therefore they swim around and around, and pass into the bowl or pound, where they are left by the tide, or, if the bowl be in deep water, they are hauled up by a net bottom. “The bowl or pound is generally in deep water, and if the trapper is, by a storm, prevented from visiting his pound for a few days, he will find his prey safely confined in the bowl.

These pounds are by far the most destructive apparatus devised, as they capture nearly every fish that strikes the leader. To show you how destructive they are, Professor Baird says that he is “cognizant of the capture of no less than twenty thousand blue fish, representing a weight of at least 1000 pounds in one weir, in the course of a single night.” One trapper testified before the Rhode Island Commission that in 1867, in nine days, he took from six traps or pounds, $18,000.00 worth of fish; he took $3000.00 worth one morning before breakfast. Some of the fish he sold at $1.00 and others at $3.00 per barrel. He took ten thousand barrels of scup. A trap at Wagnoit near Falmouth took, in 1865, of alewives alone 408,660 while a trap at Menenisia took, from April 14 to June 8, 1870, one thousand barrels of mackerel, besides thousands of other fish.

One old fisherman testified in 1870 that forty five years before, while fishing for menhaden, a fish which furnished food for other fishes, if they saw scup, they would pull up their nets for fear they would cut the seine. Ten years later they were sold for ten cents a barrel to manure the ground; ten years after they were sent to New York packed in ice, and sold at twenty five cents a barrel, and in 1880, the price was $4.50 per barrel.

It was claimed before the Rhode Island Commission that the decrease in the quantity and increase in the price of fish, had added at least $100.00 a year to the cost of maintaining each family on the sea coast. One important principle in regard to sea-fishes should be kept in mind, and that is, that every fish which spawns on or near the shore, returns as near as possible to its birth-place to exercise the functions of reproduction, and continues to do so each year during its life. The second law equally positive with a great variety of fish is that they pass from their spawning beds to the sea by the shortest route to deep water where they pass the winter, and in going to and from a given locality, they follow a determinate and definite line of migration. Keeping in mind these two propositions, we can appreciate what follows when fish are disturbed or caught during the breeding season. The

nets set along the line of approach to their spawning ground arrested them first at one point and then at another before their eggs are deposited. As most fishes require from three to five years of growth before they are capable of reproduction, and in many cases remain in the deep water until they reach that period, it follows that for several years after the establishment of pound nets and other exhausting modes of trapping, the supply may seemingly be but little affected or interfered with since there are several successive crops of fish to come at the annual intervals, and not until another round will be completed, do the traps and pounds present the evidence of their destruction. We can understand from this that why, after a few years the supply of fish should diminish from a particular day or part of the coast, and if the fish of a particular locality are caught up, there is no prospect that others will come from neighboring grounds to take their places, since those which visit a given undisturbed locality, continue to frequent it, and have no inducement to change.

Professor Baird expresses the idea in this way: “It should be understood that the exhaustion of a local fishery is not like dipping water out of a bucket where the vacancy is immediately filled from the surrounding body; but it is more like taking lard out of a keg where there is a space left that does not become occupied by anything else.”

Formerly the tidal streams were, in the spring, almost choked with shad and alewives as they struggled to ascend them to their spawning grounds; but the building of impassable dams prevented the ascent of those which had escaped the pounds and traps on their lines of travel. Their numbers rapidly decreased, and in a few years the places where a large trade was carried on in their capture, awarded but little results to the efforts of the fishermen.

The destruction of the alewife not only affected a large business done in catching and selling it but also seriously affected the cod fisheries of the New England coasts. Of all the fisheries formerly prosecuted off the New England coast north of Cape Cod, the depreciation in that of the cod is of the greatest economical importance. The alewife was the natural food of the cod, and with the decrease of the former came a corresponding decrease of the latter. Let me give you an instance. Fifty years ago, cod could be taken in abundance in Passamaquoddy Bay and off Eastport, where only stragglers could be found in 1872. The same was true of other places along the coast, where the fish came close in to the shore, and were readily caught. The harvest period was before the multiplication of mill-dams cutting off the

ascent of the alewife. The St. Croix River, and Little River above Eastport were choked in the spring with these fishes, endeavoring to ascend and the waters of the adjacent bays were alive with young fish on their return. The dams stop the alewives from reaching their spawning beds, and soon the migration ceased; and by a remarkable coincidence, if it be nothing more, the cod diminished soon after, and in a few years became so scarce that fishing for them was abandoned.

The decrease in the food fishes became so great that in the winter of 1869–70, petitions were presented to the legislatures of Massachusetts and Rhode Island, asking that a law might [be] passed prohibiting the use of fixed apparatus for capturing fish. Special committees were appointed by the legislature of each of these states to investigate the subject. The Massachusetts committee decided that there was no reasonable ground for the complaint and that any action on the part of the state was inexpedient. On the other hand the Rhode Island committee, which had examined the subject thoroughly, came to the conclusion that the petition should be granted and reported in favor of a very stringent law against the use of pounds, etc., except within a very limited district. The question before both committees turned upon the evidence of men who were interested; whose livelihood depended largely upon the conclusion which might be reached. Many had made large investments of money in nets and boats, while others, who had no such intent acted upon the natural antipathy which exists between the net and line fishermen. In some instances the witnesses were intimidated by threats on the part of the owners of the islands and nets.

As a diminution of the Coast fishes was in tidal waters, over which the United States exercised jurisdiction, it was maintained by many that the states could not exercise control, and that any laws upon the subject must be made by Congress, and especially so, because if left to the states, it would be impossible to secure the harmony and convenience of action necessary to a successful result. On February 9, 1871, Congress passed an act authorizing the president to appoint, by and with the consent of the Senate, from among the civil officers or employees of the government one person of proved scientific and practical acquaintance with the fisheries of the coast, to be Commissioner of fish and fisheries, whose duty it should be to prosecute investigations and inquiries with a view of ascertaining whether any and what diminution in the number of the food fishes of the coast and lakes in the United States had taken place, and if so, what caused the same; also whether any and what protective, prohibitory, or precautionary measures

should be adopted in the premises and to report the same to Congress. An appropriation was made by Congress to meet the expenses of the investigation, and the Commissionership was tendered to Spencer F Baird, for whom the office was in fact created, who accepted the position, and at once began the investigation.

He proceeded to Vineyard Sound, and established his quarters at Woods Hole [spelled Woods Holl, throughout], and from this place as the center of operations, he made investigations at such points on the coast as were most likely to furnish facts bearing upon the question; and about the same time, Prof. Milner, is Deputy Commissioner, began to investigate the condition of the Great Lakes.

The great diversity of opinion developed in the investigations made by Massachusetts and Rhode Island committees upon several questions which should have been well known facts in the life history of the food fishes, made it necessary to thoroughly study the natural history of these species, so as to have a more complete knowledge of the facts, and the better to reach satisfactory conclusions. Searching inquiries were made, and much valuable information obtained in regard to the general natural history of the water. The result of the first years inquiry may be summarized. 1. The alleged decrease of the food fishes was fully substantiated. 2. The decrease in the shore fishes from 1865 to 1871 was so great as to entirely prevent any successful summer fishing with hook and line. 3. The period of decrease represents the time during which the traps and pounds had been fully established. 4. In 1871 and ' 72 the decrease was so great as to reduce very largely the profits derived from the traps. The work of the Commission, authorized by the original resolution of Congress, related only to an investigation of the facts as to the alleged decrease of the food fishes of the sea-coast and lakes of the United States and inquiry as to the cause of the same, and the best method of remedying the evil. At a meeting of the American Fish Culturists' Association held in Albany February 7, 1872, it was for the first time suggested that measures should be taken to induce the United States to take part in the great undertaking of introducing or multiplying valuable food fishes throughout the country, especially in waters over which its jurisdiction extended, or which were common to several states, none of which might feel willing to incur expenditures for the benefit of others. A committee, of which George Sheppard Page was chairman, was appointed to present the subject. He visited Washington, and secured an appropriation of fifteen thousand dollars at that session of Congress, for the

purpose of introducing shad into the waters of the Pacific and Gulf States, and of the Mississippi Valley, and of Salmon, White Fish, and other valuable food fishes into the waters of the United States to which they are adapted.

Under this act, the United States government for the first time in its history entered into fish culture, but it had been before attempted in this country. As early as 1853 Dr. Garlich and Prof. Ackley had a fish farm near Cleveland Ohio, and in 1859 Stephen H Ainsworth, at West Bloomfield New York began his experiments, and afterwards Seth Green, Livingston Stone, and others became interested in the subject. Fish culture, however, dates back to a very remote period. In the 15th century the first attempt in Europe was made at the Abbey of Rocine in France, while the Chinese are said to have known of it long before. Joseph Reiny a simple fisherman of Bresse, a village in the Vosges, was the first to fully appreciate the importance of artificially impregnating the eggs, and protecting the young fish during the period of greatest danger. The limits of this article will not permit of a presentation in detail of the different modes used to propagate fish. The simplest way is to transfer both sexes from one locality to another, where they can make themselves at home, and in the due course of time increase and multiply, but this is a slow process, and therefore more expedient means had to be devised.

The course now adopted is to take the female fish when ready to deposit her spawn, and by proper manipulations press out the eggs from her body into a suitable receptacle; and then repeat the operation with the mail so as to force the seminal fluid into the same receptacle. Then the eggs are placed in a suitable vessel, through which water is allowed to flow, and a uniform temperature until the young fish appear. They are then properly fed and cared for, until they reached the age when they can take care of themselves, and they are then deposited in the waters to be stocked.

It is well known that there is no more attractive food for aquatic animals than the roe of fish; even the parent of the eggs eagerly devours them. As a rule 60% of the eggs deposited in the natural way are devoured before they are hatched. Such of the remaining 40% as may be hatched fully 3/4ths are probably eaten by other fish while in helpless state before they are able to feed and protect themselves. Many of the eggs are not impregnated, and of course remain inert. It has been repeatedly estimated that an average not to exceed 5% of the eggs laid under natural conditions become young fish able to feed themselves, but by artificial propagation as high as 95% have been

hatched and deposited in water, able to feed themselves. The eggs of a single pair of shad artificially treated can be made to produce more than those of 200 pairs of natural spawners.

In considering the work of the US Fish Commission the distinction should be borne in mind between the resident freshwater fishes and those that are anadromous; that is, those who spend a part only of their life in the fresh waters, and the remainder in the ocean. Those which belong exclusively to the fresh water, as the trout, black bass, etc. are well worthy of attention; but however rapidly certain of these fishes may multiply, there is a limit to their increase, restricted by the extent of the water and the food supply. An entirely different condition prevails with the anadromous fish, among which are best known the shad, alewife, or fresh water herring, salmon, smelt, and probably the striped bass. These fish spend the greater part of their existence, and derive their chief weight, from the sea. At certain seasons, when fat and in good condition, they entered the rivers, and proceed as far as obstructions will permit, or until they find their proper spawning grounds. The adults return either immediately or after a certain interval, to the sea, while the young fish spend a certain period in fresh water, feeding on minute organisms, which are always procurable in abundance.

Shad and herring enter the rivers and spawn in the spring, and the young return in the autumn. The Eastern salmon enter the rivers in spring and spawn in autumn, the eggs not hatching till late in winter. The young remain for one and sometimes even for two years, and then go to the sea. After a certain interval these fish return to their birthplace, the shad at the age of three or four years weighing from three to five pounds, the salmon after the same interval weighing from nine to twelve pounds; this rapid growth having taken place in the ocean through natural means.

It is for this reason that the efforts necessary to the multiplication of anadromous fish may be limited to securing a proper passage of the adults to and from their respective spawning grounds; and in addition to this in securing their eggs in numbers, and placing the young when hatched, after a suitable interval, in the water where they are to pass their infancy. Nothing is asked of the waters but the right of way, the adults only (*sic*) taking food while in the rivers. Their sustenance during this period is derived from the surplus fat of their bodies and the exhaustion produced by their abstinence and the development of the eggs and their fertilization being made up by the voracity of the fish on returning to the ocean. The whitefish, and some other

fresh-water fishes are anadromous in this, that they live in large bodies of fresh water and run into tributary steams to spawn. The anadromous fish are commercially among the most valuable, and most easily propagated. The key note to their treatment is the now well-established axiom that each will always endeavor to return to spawn if possible, to the very spot where it was first introduced into the water as a young fish, and that it will make every effort to do so, sometimes even losing its life in the persistent effort to this end. In this is the guarantee of success in attempting to stock a particular stream or body of water. If three streams empty into the same day on the coast, or are tributaries to the same principal river, and all are equally eligible for anadromous fish, although destitute of them, one of them may be stocked and abound with fish while the others may have been neglected, will be almost entirely unvisited, or will possibly become supplied very slowly And after a long period.

The tendency of fish to return to their original spawning ground at the expiration of a given time, and that young fish hatched out, or placed in the water at any given place, will, in their turn seek the same place for the purposes of reproduction, has been proven in a number of instances and ways; a number of times the same fish has been taken in succeeding years by the Commission chemist. At the United States Salmon hatching station on the Penobscot, Mr. Charles G. Atkins has been in the habit of taking and numbering the fish which he captures for his purposes, and which are released in the Penobscot when he has finished with them. Of these, quite a number have been taken in subsequent years, identified by their labels. In 1877, a hundred salmon were marked at the hatching station in Oregon, and let go; the next year ten of the number were retaken.

The resolution of Congress to which I have referred has been liberally interpreted so as to authorize a systematic investigation of the sea and Great Lakes, and the biological and physical problems which they present. Prof. Baird insisted, that to study only the food fishes, would be of but little importance. The life history of species of economic value should be studied and known, but no less important is it to know the history of the animals and plants upon which they feed, or upon which their food is nourished; then, too, their friends and enemies, and the currents, temperatures, and other physical phenomena of the waters they inhabit should also be investigated; in order to properly decide the questions presented. The methods of taking fish should be examined, in order to discard those which threatene the destruction of the useful fish, and to adopt others more serviceable. The introduction and

multiplication of food fishes was not contemplated when the commission was established, but was undertaken at the insistence of the American Fish Cultural Association, whose representatives induced Congress to make a special appropriation for the purpose. The appropriation has been renewed each year on a more bountiful scale, and propagation is at present the most extensive branch of the work of the Commission. In direct research very important service has been rendered by volunteers, and a large share of the physical explorations have been made by unpaid American specialists.

Wood Hole, on the Massachusetts coast is the permanent summer station of the Commission, but investigations have been made along the whole New England coast, and as far eastward as the British Provinces. The fishermen along the New England coast have taken a lively interest in the zoological work of the Commission, and send to its headquarters any new specimens they may find. Perhaps the most remarkable instance of this is among the Gloucester fishermen. When the Commission had its head-quarters at that place in 1878 a genuine interest sprang up among the crews of the fishing vessels, and since that time they have vied with each other to find new species. At least 30 of these fishing vessels carry collecting tanks on every trip, and they have collected about 60,000 specimens, most of them belonging to species unattainable. The report for 1880 shows that at that date over thirty species of fish have been, through the exertions of the Gloucester fishermen, added to the fauna of North America. In addition to the regular work of the commission, it has done a great deal for the advancement of science in general, by prosecuting researches in the general natural history of the aquatic animals and plants. The commission has made large collections of aquatic animals, especially of fishes, shells, corals, crustaceans, star fishes, etc., and after submitting them to careful investigation for monographic research, and setting aside a full series for the National Museum, the remainder has been made up into well identified and labeled sets for distribution to colleges and other institutions of learning throughout the United States.

There is nothing that so much increases the interest in Natural History as the opportunity to examine actual specimens of rare and usually unprocurable specimens instead of depending upon descriptions or drawings. The calls for the specimens are usually made through the members of Congress representing the district in which the institutions established.

In connection with fish culture, much attention has been paid to embryology.

The breeding times and habits of nearly all our fishes have been studied, and their relations to water temperature. The embryological history of a number of species such as the cod, shad, alewife, salmon, smelt, Spanish mackerel, striped bass, white perch, the silver gar, the clam, and the oysters have been studied under the auspices of the commission. The new steamer Albatross, built expressly for the commission with her apparatus for sounding and dredging, has enabled the commission to investigate the bottom of the sea, and many new species have been brought to the surface. Records of ocean temperatures have been made, and many new facts discovered, of scientific interest. I will not detain you with a detailed statement of the scientific work done. From a scientific point of view the commission is a success. To return to its economic work. –

Some persons seemed to think that the commission would at once supply the coast and lakes with an inexhaustible supply of fish. They should remember that fishes have to contend, not only against their enemies in the water, but also against the demand for them, which increased with the increase of population, and the enormous facilities given to the fishermen, by which fish may be captured by the wholesale, has complicated matters. If the rude appliances of a hundred years ago were sufficient to depopulate a river of fish, imagine the effect of the injurious traps and miles of nets with which the fish are met today. Fish culture has not only the rude appliances of a hundred years ago to contend with, but has also the accumulated ingenuity of man since then to circumvent. The limits of fish culture are precisely those of scientific agriculture and animal rearing. Although certain physical conditions may intervene, to thwart man's efforts in any given direction, it is quite within the bounds of reasonable expectation to be able to understand what they are, and how their effects are produced. We must remember that the demands made upon the fishes by the destructive methods of their capture, and the enormous masses of them required to supply the market, had reduced their numbers to an alarming extent. Salmon had ceased to visit the rivers of New England, and the supply of shad was so limited as to scarcely repay the fisherman in his endeavors to catch them.

The first and great task of the Commission in its work of fish culture was not so much to increase at once the number of edible fish in any given water, as to withstand the enormous forces at work to produce their annihilation. Take, for instance, the Potomac River. For some years before the war the shad fisheries upon that river had been practically exhausted; it was unprofitable to fish the stream. The occupation of the shore by hostile forces for nearly

four years prevented the carrying on of the fisheries, and gave nature an opportunity to restore the fish. At the close of the war it was found that the river had been restocked, and for a few years the yield was very large. The number of fish called out the fishermen, and there was a steady decline in the yield, and had it not been for artificial propagation, there would not now be shad enough in the river to warrant the fishermen in trying to catch them. Fish culture was brought in as a restorative. Since 1873, the commission has annually hatched young fish, and deposited them in the river, the number increasing annually. In 1885 there were hatched at the Battery Station, Potomac and Delaware river stations 36,860,000 shad which were for the most part deposited in the Potomac and Delaware rivers. At the Potomac station 15,531,000 of this number were hatched, at a cost of $330 for each million or more than thirty young fish for each cent of expenditure. In the Potomac River alone the annual yield has, by the United States Fish Commission, then brought up from 668,000 lbs. in 1877, to more than 1,600,000 lbs. in recent years. The result has been that the commission has not only prevented the annihilation of the shad, but has increased the supply. Were it not for the Commission, the large shad fisheries of the Potomac and other rivers, would be matters of the past. Shad have been successfully planted in many streams emptying into the Pacific, and many barren streams in the South Atlantic Coast were stocked, and are now visited by them in sufficient numbers to warrant the establishment of fisheries to catch them, while every shad river in the country, has been improved.

In 1880, 1,000,000 shad fry were planted in the waters of Georgia, and in 1881 1,800,000. In three years after the planting they returned to find their spawning beds in large numbers. There is a singular fact connected with this plant which shows the natural instinct of fishes. The fry constituting this plant were Connecticut River Shad which will take the bait, and can be caught with hook and line, while the South Atlantic Shad do not take the bait. The shad which appeared in these planted rivers, true to their instincts, were taken with hook and line. The success implanting the Connecticut River and other rivers in New England has been equally great, but here assistance has been rendered by the Massachusetts and Connecticut State Commission.

The work done at Farmington River Connecticut shows how the fish culturists can control the supply for several years previous to 1879, artificial hatching of shad was then carried on, but was discontinued in that year. Bear in mind that three years are required for shad to mature, and notice the result.

1881 there were caught 11,505 fish.
1882 " " " 3800 fish
1883 " " " 1155 fish

in 1881 the hatching and planning of young fish were resumed, and in 1884 the increase began; but I have not the data from which to state the exact number caught.

The condition of affairs on the Great Lakes presented a difficult problem to the Commission, and called for its greatest efforts. In 1871 there were 281 pound nets and 481 gill nets used on Lake Michigan. In 1879 there were 476 pound nets and 24,599 gill nets, and 30 steam tugs to attend to them. There were nets enough to reach around the lake. The large fish have been caught, and it therefore became necessary to decrease the size of the mesh of the nets; without the aid of fish culture in ten years at the farthest, the whole fish and trout fisheries of the lakes would have been exhausted. The decrease has been arrested, and the supply is on the increase.

The number of white fish hatched and planted has been increased each year since the commission began its work. From the two great hatcheries at Alpena and Northville Michigan, there were deposited in the Great Lakes in the spring of 1884, 49,000,000 white fish, besides those deposited by the several state commissions. (Rep Comt 1883, Goode 1884)

It was not long ago that the majority of the men representing the capital employed in the fisheries of the Great Lakes had little faith in artificial propagation as a means of increasing the supply, or in preventing a decrease, but those men are now the strongest friends of the Commission. The catch of fish was greater in 1883 than for several years before. This was gratifying to the commissioners as the result of the larger plantings could not fairly be called due until that year. The testimony of a number of fishermen has been taken on the question of this increase, and some testified that their individual catches in 1884 was twenty tons, others thirty tons, and others fifty tons in excess of their catch in 1883. The fishermen of the lakes now admit that were it not for public fish culture half of them, at least, would be obliged to abandon their calling.

The propagation of salmon in California is another remarkable success of the commission. The Bulletin of the commission for 1884 (Bull 1884, p. 68) states that "the salmon canneries of the Sacramento River annually increased

in number until, by 1870, the entire run of salmon was being caught and utilized. The greatest natural capacity of the river under these circumstances may be considered to have been reached in 1875 and 1876 when the average yield to the canneries was 5,205,102 lbs. The first possible fruits of fish culture where in 1876, when the young of 1873 may be supposed to have returned. The US Hatchery was established in the latter year at Baird, Shasta Co. California and half a million young released in 1873 and again in 1874. In 1875 the number was increased to 850,000 in 1876 to 1,500,000, and during each of the years 1877, 1878, 1879, 1880, 1881, 2,000,000 young fry were placed in the river. From annual catch of 5,025,102 lbs., the river has come up to the annual catch of 9,596,984 lbs. allowing the three years which it takes for salmon to come to maturity, and enter the river for spawning purposes, the increase in yield to the canneries has been almost exactly proportional to the increase in the deposit of fry."

There was an actual gain per annum due to fish culture of 4,391,882 lbs. The fish are worth fifty cents each, as they come from the water, their average weight being seven pounds.

Value of the 4,391,882 lbs. due to fish culture.	$313,706.00
Cost of hatching and planting 2,500,000 fry.	$3600.00
Annual net profit.	$310,106.00

These figures show the large profit realized from fish culture when conducted under favorable circumstances. Carp, whenever planted under favorable conditions, and receiving reasonable care and attention, have grown and multiplied rapidly; 30,000 distinct bodies of water in every section of the United States have been stocked with these fish. (Bull. 1884 pp. 261–2) These represent an area of 100,000 acres of waste land which have been turned to profit, yielding at a moderate estimate 20,000,000 lbs. of food per annum, and adding $1,000,000 annually to the products of the country. Black Bass have been accumulated in all the rivers of the Atlantic slope, and although they may not have added much to the food supply, the introduction of this game fish has contributed to the prosperity of the various sections, by attracting sportsmen and summer residents. The trout streams of New England, of New York, and in parts of the states of the Northwest are kept up by artificial propagation and protection through the State Commissions. It is estimated that the summer visitors of New England and New York, drawn there by the hunting and fishing, leave annually $15,000,000 behind them, according to the statement of the New Hampshire Commissioners (Bull. ' 84 p. 262)

The Atlantic salmon, land-locked lake trout, cod fish, and other valuable food fishes, 22 and all, have been successfully propagated and distributed, and arrangements have been made at the Woods Hole Station to propagate the cod in large numbers. (Report 1883 p. LXXIV) in 1878-79, this fish was hatched at Gloucester, and the result of the work was apparent in the increase of the catchers made off that place and Portsmouth

The attention of the Commission has been directed to the oyster, the supply of which decreased about one half between 1880 and 1883. The preservation of the oyster-beds is a matter of vital importance to the United States, for oyster fishing, unsupported by oyster culture, will, within a short period destroy employment of thousands of people. Oysters have long been raised in artificial enclosures, from spat naturally deposited upon artificial stools. In July 1883 Mr. John A Ryder, an assistant to the US Commission solved the most difficult problem in American oyster culture by discovering a mechanical device for preventing the escape of the newly hatched oysters while swimming about prior to fixation.

The economic work of the commission has not been confined to the propagation of food fishes. The cod fishermen have been taught the use of gill nets, thereby to avoid the great expense of bait. When this fish is the most abundant, bait is very difficult to obtain, and commands a very high price. These fishermen have also been taught how to preserve their nets, to improve the model of their vessels, and better ways to cure and pack their fish for market. The commission has investigated the habits of the migratory fish, to enable the fishermen the more readily to find them, and it has made extensive investigations of the offshore grounds, to find new localities where the fishermen can pursue their calling with profit. It has discovered that off the whole New England coast there exists, in extraordinary abundance, and before entirely unknown to fishermen, the large flounder known in Europe as the Pole or Craig flounder. It is a delicious fish, quite similar in gastronomic excellence to the turbot. It was taken by the trawl in large quantities. Its mouth is so diminutive that a hook sufficiently small to be swallowed by it will not sustain its weight; but it can be easily taken with the trawl, and is destined to become a valuable food fish.

Perhaps the greatest disappointment that the commission has experienced was with the Tile fish. A few were accidentally taken by a Gloucester fishing vessel in 1879, and delivered to an agent of the commission who sent

them to its head quarters at Washington. They were carefully investigated, and found to be a new genus and species of food fish. In September 1880, the steamer Fish Hawk, belonging to the commission proceeded to the locality where they were taken, about seventy five miles south of Newport on the Gulf Stream. On putting down the trawl net, the bottom of the sea was found to be rich in animal life. The quantity of crabs and shall fish furnishing food for fishes was incalculable. The fishing lines were then brought into [ ], and the Tile Fish found in abundance. In three successive trips of the vessel, the fish were traced over an extent of 60 miles, where they appeared to be as abundant as cod fish on their banks, and were taken with even greater facility with the hook. This fish which, two years before was entirely unknown, even to fishermen bid fair to constitute an important object of pursuit, and to be of great commercial value. In March and April, 1882 the vessels which arrived at the Atlantic Sea-port reported having seen large numbers of dead fish, floating on the surface of the sea, between the latitudes of Chesapeake and Nantucket. Such a phenomenon had never been before known on our coast. These dead fish proved to be tile-fish, and subsequent investigations of the ground where the tile-fish were two years before found in abundance, failed to find a single one. They seem to have been all destroyed, or if not all exterminated, what escaped had gone to other grounds, and they have not since been rediscovered.

The policy of the United States Commission has been to carry out the idea that it is better to expend a small amount of public money in making fish so abundant that they can be caught without restriction, and serve as cheap food for the public at large, rather than to expend a much larger sum in preventing the people from catching the few that still remain. After generations of improvidence, the salmon rivers of the Pacific slope, the Shad Rivers of the East, and the white fisheries of the Lakes are now so thoroughly under the control of the fish culturalist, that it is doubtful if anyone will venture to contradict this assertion. Prof. Goode says: “It has been demonstrated that the great River fisheries of the United States which produced, in 1880, 48,000,000 lbs. alwives, 18,000,000 lbs. Shad, 52 million lbs. Salmon, besides bass, Sturgeon, and smelt worth, ‘at first hands’ between four and six million dollars are entirely under the control of the fish cultural (*sic*), to sustain or destroy and are capable of immense exten–tion.” (Goode, 23)

To the middle of 1883, there had been appropriated by the government for the use of the commission $1,190,955, for which about one fourth should be credited to the account of the ocean fisheries inquiry and the construction of

the steamer Albatross, leaving a balance of from $750,000 to $800,000 expended in fish propagation. In the prosecution of its work the Commission had in operation in 1883, seventeen stations. It has the new steamer Albatross for deep-sea investigations. The Fish Hawk, devoted to hatching and transporting young fish; the steamer Lookout, engaged in investigating the oyster question; two small steam launches, and two cars to transport live fish to the places where they are to be deposited in interior waters. In 1883 Car No. 1 traveled 31,993 miles and distributed 6,750,000 shad; 5,550,000 herring, 113,605 carp, and 450,000 salmon. (Rep. 1883)

I would like, if time permitted, to tell you about the laboratory at the Woods Hole station. Should any of you be in Eastern Massachusetts next summer, go and visit it; it will well repay you. A person who shows the least intelligent interest in the work of the Commission is sure to receive attention from the naturalists there at work. A more intelligent and courteous set of men than they can not be found. Although their time is fully occupied, they will find time to show the visitor the specimens collected, and answer intelligent questions. The yellow pine walls, the pine tables and bookshelves, mark plainness and economy. Each table is occupied by its student of nature. In glass jars standing round the room, there are rare and curious marine animals. On a long bench there are aquariums. In these many shore animals are kept. You can see the star fish as it devours its shelly prey; the sea anemone as it expands and presents its snowy tentacles; the pugnacious hermit crab as it tumbles about, and the horse shoe crab bumping against the glass, vainly trying to get out of its restricted quarters. When you shall have seen these and many more interesting objects and have occupied all the time of the scientists that your conscience will permit, then go down to the dock to the steamer Albatross if she should happen to be in port, and see the apparatus used in dredging. She is the finest steamer for the work in the world, and has a world-wide reputation in scientific circles. Her officers are always ready to show a visitor about the vessel, and to explain her machinery and apparatus. The only regret connected with your visit will be that you did not stay there longer. In closing, I wish to call to your notice a few of the many complimentary remarks which Europeans have made about our Commission, and the American exhibit at the International Fisheries exhibitions at London and Berlin; to look at our work through foreign eyes.

“Prof. Huxley, commenting upon an address delivered at the conferences of the London Exhibition, by G. Brown Goode assistance Commissioner, said ‘the great moral force of the United States contribution to this Exhibition,

and especially of the contribution which Mr. Brown Goode has just made, to the Conferences, was that if this country or any society which could be formed, of sufficient extent to take up the question was going to deal seriously with the sea fisheries, and not to let them take care of themselves as they had done for the last thousand years or so, they had a very considerable job before them; and unless they put into that organization of fisheries the energy, the ingenuity, the scientific knowledge, and the practical skill which characterized his friend Prof. Baird and his assistants, their efforts were not likely to come to very much good. One of his great reasons for desiring that the subject which Prof. Goode had put before them should be laid directly before the English public, was to give them a notion of what was needed if the fisheries were to be dealt with satisfactorily; for he did not think, speaking with all respect to the efforts made by Sweden, North Germany, Holland, and so forth, that any nation at the present time had apprehended the question of dealing with fish in so thorough, excellent and scientific a spirit, as that of the United States.'

"'If there be," wrote in 1879 Sir Rose Price, "any race of people who exhibit more shrewdness than others in their ability to grasp and manipulate the apparently indistinct elements of what may lead to a commercial success, or be of ultimate benefit to their nation, those people are the Americans. No government throws away less money in useless expenditures, and no representative assembly more narrowly criticizes waste, yet the Americans subsidize considerable sums of their national revenue for the purpose of restocking the rivers of the Eastern States by artificial culture, and with praiseworthy considerations, their government supports several ably conducted establishments from which fish ova are distributed gratis to all those who choose to apply. The very railroads assist this enterprise, and some, by moderating their tariff, and others by generously conveying the ova free of charge, give every possible encouragement to what their common sense tells them must lead to so much national good. To expect an English government to exhibit the same amount of foresight, or to practice a similar generosity would be to credit them with virtues which have yet to be developed. The American example should not be lost sight of."[*]

"'The Rev. WS Lach-Szyrnia, of Newlyn, England, in a lecture upon the late Exhibition, made the following comparison. "At the Paris exhibition he

[*] The Fishing gazette, London III p.65

considered Europe as a man of full vigor, Asia as a decrepit old man, America as a boy, Australia as a baby. In the present Fishery Exhibition, the case was different. ———America was the gem of the exhibition.'

"'Norway. In a report to the Norwegian Government, after his return from a visit to the United States in 1876, Mr. F. M. Wallern one of the principal fishing authorities in that country wrote "in a book on trout culture written by a practical breeder, it is said….. That it pays better to rear trout than hogs,' and everyone knows what the pork business is for America. All that I have learned indicates that this assertion has gained general acceptance, both among the common people in the learned; and it is said to be admitted that in the art of rearing fish, the Americans surpass all others.'

"'The Netherlands. I quote a few sentences from a recent essay on the London Fisheries Exhibition by Prof. A. A. W. Hughbrecht, of the University of Utrecht, one of the Dutch Commission of fisheries, to show his appreciation of our Commission, and especially of its success in raising the cod." Whilst in your up fish culture, if not exclusively, principally occupies itself with the Salamandae. America also raises artificially, other kinds of fish, even codfish. As regards the last named species, this seems almost incredible. Whenever I have taken the trouble to protect a codfish, when still in the egg, and as a young fish, I found that in that condition it was worthless for us, because to make it grow as it should, it must return to its own element, the sea; and there to find him again at a later period, seems just as hopeless as the desire of Polycrates, that the waves of the ocean should return to him his golden ring. And still, correct as this reasoning may appear, the Americans will prove the whole thing to us in dollars and cents; whilst the delighted fishermen of Gloucester will soon convince you of the contrary if you were to tell them that their increased codfisheries were simply caused by accidental circumstances, and not by the energetic work of Prof. Baird and the United States Fish Commission.– – The head of the American commission to London said to me: "In our country we would as little think of leaving fish-culture to private effort, as of taking from the hands of the Government the care of the light houses." Well said, but not very pleasant for the ears of true adherents of the Manchester school. These words should be taken to heart in Europe, and especially in the Netherlands. It is to our immediate interest that – – – we may be the first to reap the fruit of American teaching, and to take the front rank in the European Fish markets, which belong to us rather than to other countries which, owing to their location, are not able to imitate the example set by America as well as we

can." Referring to the US Fish Commission he says: "under the supervision of the Commissioner there is a full staff of experienced and skillful naturalists which works into a whole all the various observations and orders the new investigations called for by such observations. Their ranks are filled by young men who, after having completed their education at some college, desire to devote themselves to the science of zoology more especially in a field where that science promises not only to supply many of the daily wants of the masses, but where it has already accomplished a great deal. They are the men who use for investigation in the field of embryology the exceedingly valuable scientific material furnished by the numerous stages of development of fish, which may be observed in a practical fish culture. We may doubtless look for important communications relative to the result of these scientific investigations. Round this staff of scientists there has gradually been formed an entire camp of officers who are thoroughly versed in the more mechanical work of fish culture and fish transportation. The catching of mature fish, the impregnation of eggs, the care of them during their development, and the raising of the young fish can only be entrusted to experienced persons, although a scientific education is not required for this work."'

"Dir. Haack, the head of the Imperial hatching establishment at Hüningen in the paragraph of this report relating to the American section at Berlin says: 'everything which America had sent, was on a magnificent scale. We shall therefore only – – –admit the truly superb scientific collection, filling several rooms, and finally devote some time to the department of piscaculture. Much of the apparatus was already known to us, as for about three years we have imitated the Americans in this respect. ——Lost in astonishment, we stand before the large model of the Fish Hawk a large steamship specially constructed by the American Government for purposes of pisciculture …. With all our piscicultural efforts we must confess that we felt very small when viewing this grand American exhibit, and the magnificent results obtained in America are sufficient guarantee that this is no 'American humbug.' For the present we can certainly do no better than to strain every nerve and imitate the example set us by the Americans.'

'The juries of the Fisheries Exhibition of Berlin in their official report remark "'we must thank America for the progress which fish culture has made during the past decade, and the new inventions through which this progress has been accomplished were very fully shown at the Exhibition. The American section was therefore in the highest degree instructive and

interesting to every practical fish culturist.'

"France. Mr. C. Raveret Wattel, The principal French authority on pisciculture in a recent essay writes: "to this day pisciculture he has nowhere produced results which can be compared with those obtained in the United States. In no other country has this industry obtained to the same degree of development, perfection and success. But it must also be said that perhaps no other nation has so fully understood the great importance of pisciculture and that in no other country have such great efforts been made. No where certainly has so much been accomplished by private enterprise: nor has the government given so much enlightened care to the rational cultivation of the waters, and afforded such efficient protection and generous encouragement.'"

I could devote a large part of the evening to reading the many complementary things said about our success in fish culture, but what I have read is sufficient to show that the work done by the Commission is appreciated by Europeans.

At the International Fisheries Exhibition held in London in 1883, the American Exhibitions were awarded 50 of the 187 gold medals while at the Berlin exhibition in 1880 they carried off 6 of the 10 gold medals; and to Prof. Baird was given the grand prize. In the words of the President of the German Fisheries Union, it was given to him as "the first fish culturist of the world." Professor Baird is entitled to the larger part of the credit for the improved condition of our fisheries. He stands among the foremost of the scientists of the world, and for years has been a leader in biological investigation. He realized from the first the necessity of a scientific foundation for the work, and his position in the Smithsonian Institution established for the "increase and diffusion of useful knowledge among men," enabled him to call to his assistance the most eminent men of science in the country, and trained specialists who have ably seconded him in the work, and to him and to them great praise is due for so successfully cultivating the sea, and supplementing the harvest of the fields by the harvests of the waters.

Herbert Jenny

March 20, 1886