

IV.—WORK AT COLD SPRING HARBOR, LONG ISLAND, DURING 1883 AND 1884.

By FRED MATHER.

I beg leave to submit the following account of the work at the hatchery under my charge :

The new station of the New York fish commission, leased in 1882 and established in 1883, and designed for hatching both salt and fresh-water fishes, is situated on the north side of Long Island, 32 miles east of New York City by railroad. The harbor was formerly a whaling station, and many old buildings connected with that industry still remain there unoccupied. The line between the counties of Suffolk and Queens runs through the center of the harbor, and while the village and post-office is in the former county, the hatcheries are in the latter. There are two points of especial excellence in the site which will at once commend it, and these are the elevation of the springs, one of which is fully 50 feet above the hatcheries, and the proximity to salt water, which at half tide is only 200 yards away.

Some time in the year 1882 the place was in charge of Mr. Jonathan Mason, one of the men from the New York station at Caledonia, but for some reason not known to me the work was abandoned, and Mr. Mason returned to Caledonia. I visited the station on December 15, 1882, to see what had been done and to note what would be required. On the lower floor of the old mill a distributing trough and six hatching troughs, with thirty-six wire trays, were found. The troughs were 15 feet long and 14 inches wide and were well made, but water had been left standing in them since Mr. Mason left the station, and ice had burst them. A carpenter was ordered to repair them and to make eleven more, and also wire-cloth and other fittings were bought. On January 1, 1883, I came to the station to begin work. I raised the water in the spring reservoir 1 foot and brought it on the second floor of the old mill, and brought nine old hatching troughs from Roslyn, Queens County, where I had hatched salmon for the U. S. Fish Commission the winter before. These old troughs had been hurriedly made of poor lumber, and were placed out-doors in two lines, and received the water from the lower floor, practically making a three-story hatchery. The next year I lowered the water in the reservoir to its former level and used it only on the lower floor; also I brought down,

from the hill above, a spring into another building near by, and fitted it for hatching. This water passes into the upper story of the older hatchery, and, after being used there, flows into the ponds.

The work at the station was begun on January 1, 1883, by the joint operations of the United States and the New York fishery commissioners, and has been continued by both commissions since. The grounds were given, rent free, by Mr. John D. Jones and his brothers, Townsend, Samuel, and Edward, and the upper spring by Dr. O. L. Jones, and in addition to this, Mr. Townsend Jones has given stone from the Connecticut quarries to build a sea-wall to hold the tide at all times. Two old buildings have been fitted up as hatcheries, and the work done in the short space of time will bear close inspection and comparison with older establishments.

In the freshwater department the present capacity of the house has been nearly taxed by the hatching of 500,000 salmon, 10,000 land locked salmon, 38,000 rainbow trout, 50,000 European trout, and 1,000,000 whitefish. The fact that the European trout were in five different lots, which will be enumerated further on, rendered it necessary to place them in separate troughs, even though as small a lot as 2,000, taken from one English stream, were kept separate in a trough which could just as well have accommodated 30,000. The whitefish table will hatch 4,000,000 as well as 1,000,000, so that at present we can say that the capacity of the hatcheries is 800,000 salmon and 4,000,000 whitefish. This can be increased, if necessary.

DIVISION OF EXPENSES OF THE WORK TO JUNE 1, 1883.

From January 1 to June 1 the U. S. Fish Commission paid my salary, and that of my assistants for April and May. During the winter I employed one man at \$1.50 per day, and two girls at 50 cents. The girls were very handy at picking out eggs, but the place was too cold and the snows too deep for them to work out-doors. The U. S. Fish Commission also paid the transportation on the fry of salmon and land-locked salmon to the Adirondacks and to Salmon River, Oswego County, and sent a hatching-table and sixteen McDonald hatching jars, completely rigged with glass and rubber tubes and a supply pipe with the peculiar brass cocks used with these jars. During the season of 1883-'84 the division of expense was much the same, the State of New York paying for improvements on the grounds in making ponds, grading, &c., and in building a large salt-water pond where the tide is held by a floodgate at low water and from which it is pumped into a reservoir on the hill and then led into the hatchery in iron pipes, some of which are galvanized and others are covered with coal-tar.

BROOK TROUT (*SALVELINUS FONTINALIS*).

Our native brook trout were formerly abundant in the ponds on this place, but owing to a lack of protection they were very scarce when the

land was leased to the Fish Commission, about fifty fish being the extent of their number. In 1883 150,000 eggs of the brook trout were presented by the U. S. Fish Commission from the ponds at Northville, Mich., in charge of Mr. Frank N. Clark. The eggs were good, and according to our records the loss in the egg was 9,000, and of fry 19,000, leaving 122,000 when ready for planting. The next year we received 6,000 eggs of this fish from the United States and the fry was planted in ponds near Locust Valley, Long Island, and at Cold Spring Harbor.

RAINBOW TROUT (*SALMO IRIDEUS*).

Of the rainbow, or California trout, we had two lots of eggs direct from the breeding-ponds of the U. S. Fish Commission on the McCloud River, California, one lot from the hatchery at Northville, Mich., and one from the New York station at Caledonia. None of the eggs were in first-class order and the embryos in many instances burst the shell only to die. The first lot of 30,000 from California either failed to hatch or died shortly after hatching, the majority dying in the egg. The second lot, of 15,000, from the same place, did better and yielded 12,000 fry. The third lot, 30,000, from Caledonia, produced very weak fish of which numbers died about the time of taking food, most of them refusing it altogether. Out of these three lots, aggregating 75,000, we obtained only 26,200 fish. Of 1,000 kept in one of our rearing-ponds there were perhaps 300 fish on January 1, 1884, from 4 to 6 inches in length, showing a remarkable growth. The house being full, the eggs were hatched in the troughs outside where none of the eggs did well. There being no fence about the place the public had access to the troughs at times when the attendants were absent, and the sun was often let into them with injurious effect. During the summer of 1884 these fish did not grow well, although bountifully fed, and they died freely, so that at the close of the season when they were transferred to the larger ponds there was only 68 out of the 300 left. This is a fish that I have never fancied much; and I am in greater doubts as to their value since reading the last report of the New York fish commission, which says:

“A good deal is to be learned yet respecting temperature and other local conditions affecting fish. Till the past year not enough has been done in stocking with rainbow trout to warrant a judgment of their ultimate success in the waters on the Atlantic side. Their time of spawning occurring at a different season from that of the native brook trout, it would not seem to be policy to plant them in waters inhabited by that fish. The protective seasons would need to be different, and inhabiting the same waters one kind might be taken often when the other was fished for, and thus unintended violations would be liable to occur. An obstacle to their ready success in our waters presents itself in the circumstance that at the season the fry are ready to plant, all other fish

are greedily feeding, and consequently a considerable share of the fry would be consumed for food. This, however, may be avoided by providing places where the fry can be free from the presence of predatory enemies till they are able to look after their own safety.

"From the circumstance that they have not always been readily found in the second year, where the plants have been made, it has been surmised that they are a migratory fish—working their own way, as soon as they attain any considerable growth, down-stream toward the ocean. Their disappearance, however, may be accounted for by the other cause stated. Further experiments will be necessary to solve all the problems connected with their establishment in the eastern waters; but the promise continues to be that they will prove themselves a fish of great value in stocking large streams whose temperature is too high for brook trout."

An editorial note in *Forest and Stream* of May 1, 1884, written by myself, says of the rainbow trout:

"We would call attention to the paragraph in our notice of the report of the New York fish commission concerning these fish. It is beginning to be learned that they are migratory, and do not remain in brooks. We have never been much in favor of this fish, because we have known, what is not popularly known, that the fish is strongly suspected to be a salmon. There is no difference that an ichthyologist can find between the *Salmo irideus* and the salmon known as 'steelhead,' 'hardhead,' and 'salmon trout' on the Pacific coast, the *Salmo gairdneri*. Although this is the case, and the species *irideus* is a doubtful one, yet it has been thought best not to combine them for the present. We have been waiting and watching the habits of this alleged trout with great interest in order to learn if its habits might not show it to be in some respect different from the steelhead. The evidence of the commission tends to show that it is a migratory fish, and if so it may escape to sea and be lost, as the other California salmon were. We believe that Mr. Roosevelt has not seen the rainbow trout which he planted in streams emptying into Great South Bay, Long Island, since they were yearlings."*

If this fish has to be confined by screens to prevent its migrating and perhaps entirely disappearing, as the quinnat salmon did, then it will be useless in our open brooks. The promise of the rainbow trout was that in it we had a quick-growing fish, which was not as sensitive to warm water as our own *fontinalis*, a desideratum which now promises to be filled by the brook trout of Europe, *Salmo fario*.

*At the meeting of the American Fish-cultural Association in Washington, in May, 1884, this assertion that *S. irideus* was identical with *S. gairdneri*, which I regarded as rash for one of my limited ichthyological knowledge, was sustained by no less an authority than Dr. Tarleton H. Bean, who thought, however, that it was best to retain the distinction for a while. The only point that I know of which is against the identity of these fishes is the alleged fact that *irideus* remains in the streams of the Pacific slope all the year, after reaching the breeding size.

BROWN TROUT (*SALMO FARIO*).

Early in 1883 the eggs of this species were sent to me as a personal present by Herr von Behr, president of the *Deutsche Fischerei-Verein*, one of the most earnest and enthusiastic fish-culturists in the world. Two varieties were sent, one from the deep waters where they grow large, as in our Maine lakes, and the other from the swift mountain streams of the Upper Rhine, where they are smaller. In 1884 he repeated his gift by sending some to the U. S. Fish Commission, in my care, and some to Mr. E. G. Blackford, commissioner for New York. In 1883, when the fish were sent to me personally, I gave some of them to Mr. F. N. Clark, superintendent of the United States station at Northville, Mich., and to Mr. M. A. Green, of the New York station at Caledonia. Both report them as doing well. In 1884 a lot of 10,000 was presented to the New York fishery commission by Mr. R. B. Marston, editor of the London Fishing Gazette. Of the eggs from Germany the first year the large variety did not hatch as well as the small kind, most of them hatching head first, and both died freely before taking food. The second year they did better and many were distributed to New York waters. The English fish did better at first, but many died during the first three months. At the meeting of the American Fish-cultural Association, in May, 1884, I exhibited some of the large German trout which died in October, 1883, when about six months old, and they were fully six inches long and plump.

These specimens jumped out of the wooden rearing ponds, whose vertical walls project over a foot above the surface of the water. This fish seems to be given to this form of suicide, and it was only when their numbers had been severely thinned by it that we learned that they seemed prompted to it every time they were disturbed, either by putting in a net to catch specimens to show to visitors or at night by some animal swimming in the pond. In November, 1884, when they were a year and a half old, we removed them to a large breeding pond, and the next morning the ground was covered with them, although this pond had banks a foot higher than the rearing ponds. At present not over fifty are left, and learning their habits has been expensive. I had no intimation of this habit from any of my European correspondents, and the fish differs in this respect from our own trout, which readily accepts capture and transfer.

This European brook trout has a larger scale than ours, and to my eye is a more beautiful fish than our own trout. It is a fish that from its habit in Europe should live in the Hudson from North Creek, or above, down to Troy. In Europe it is abundant in the south of England, while the chars, of which our so-called trout is one, are only found in the deep, cool lakes of the north. I believe that we have the necessary conditions on the Atlantic coast to acclimatize successfully this fish. Herr von Behr has promised to send another shipment of eggs,

and in future we will guard against the suicidal instinct, of which we have learned at so much cost.

WHITEFISH (*COREGONUS CLUPEIFORMIS*).

One million whitefish eggs, from Northville, Mich., were presented by the U. S. Fish Commission in 1883, and were hatched with a loss of only 4 per cent, or 40,000 eggs. Some of the eggs were further advanced than others, and the fry of these (360,000) died before it was decided where to plant them. Six hundred thousand were planted on Long Island, near River Head, in Great Pond, a deep, cold lake, which appears to present the requisite conditions for their support. In 1884 the same number was received, and 400,000 planted in Great Pond, 375,000 in Lake Ronkonkoma, in the middle of Long Island, and 75,000 in "Saint John's Lake," a mill pond at Cold Spring Harbor.

The great surface exposure of the reservoir at this station is favorable to the late hatching of the whitefish. The temperature of the water in the hatchery for the month beginning February 23 and ending March 23 varied from 34° to 48°, the mean being 38½°. Shipments of whitefish were made in 1884 to Great Pond on February 15 and to Lake Ronkonkoma on March 19. This is as late as the fish are hatched in the cold lakes, and the young will find food when planted in March.

SHAD (*CLUPEA SAPIDISSIMA*).

On May 20, 1884, I received 80,000 shad eggs from Washington, in compliance with my request to be allowed to experiment with them in spring water. They were placed in the McDonald jars, and on May 29 there were planted in the Nissequague River, at Smithtown, Long Island, 78,000 fry. This seems to have been the first trial of hatching this fish in spring water, and as Col. M. McDonald wrote me that the success privately reported might revolutionize present methods I will give the details in full.

[May 20, received 80,000 eggs at 6.20 p. m., put them in the jars at 7.30 p. m. Temperature of water 58° Fahr., of eggs 55°. Eggs began hatching May 24, finished May 27.]

Date.	Temperature of water.	Loss of eggs.	Loss of fry.
May 21.....	60	30	.....
22.....	59	45	.....
23.....	60	60	.....
24.....	71	40	125
25.....	62	25	20
26.....	60	20	42
27.....	58	15	600
28.....	59	.....	150
29.....	60	.....	40
		235	
Dead on unpacking.....		380	
		615	1,177
Total loss.....			1,792

A similar trial made later proved a failure.

From the above table of losses and the round figures given as planted it will be seen that there is a discrepancy of only 208 fish, and these are on my side. Further, my estimate of the eggs received exceeds that of Colonel McDonald by about 5,000. The cool spring water, say, of about 60° (the mean of the above table is 60°.7), seems to account for the absence of fungus on the dead eggs. Having hatched shad eggs in iced water (see Report U. S. Fish Commissioner for 1873-'74, and 1874-'75, pp. 372, 376), and on the rivers of the Atlantic coast from the Pamunkey to the Connecticut, where it has often reached 80°, I find spring water at about 60° to be the best medium for shad eggs which I have used. In the summer of 1884 I made an examination of the shad fisheries of the Hudson for the New York fish commission to find the best place to take eggs. There are several points on the river where eggs can be obtained, and these lie between Kingston and Hudson. The catch of fish during the season of 1884 was a very fair one, owing, no doubt, to the plantings by the State and by the U. S. Fish Commission.

SALMON (*SALMO SALAR*).

During the spring of 1883 295,000 salmon were distributed to the headwaters of the Hudson and Salmon Rivers, in the State of New York, being the fry from 350,000 eggs of the Penobscot salmon received from the United States salmon works at Orland, Me.

In 1884 there were planted in the same waters 448,700 fry from 500,000 eggs received from Orland. Tables giving the particulars of the distributions will be found at the close of this report. The Salmon River referred to is the one emptying into Lake Ontario near Pulaski, Oswego County, New York, and not the Salmon River of Franklin County, New York, which flows north into the Saint Lawrence River.

LANDLOCKED SALMON (*S. SALAR*, *var.* *SEBAGO*).

In 1883 100,000 eggs of this splendid lake salmon were received from the U. S. Fish Commission from the breeding establishment in Maine, in charge of Mr. Charles G. Atkins, Professor Baird reserving 10,000 of the fry to be distributed as he might direct, and the remainder to be at the disposal of the New York commission. Eighty-five thousand fry were distributed, as per table.

In 1884 there were received 41,500 eggs of this fish, most of which were sent to the Bisby Club, at Bisby Lake, Herkimer County, New York, at the request of General R. U. Sherman, of the board of New York fish commissioners.

POPULARITY OF THE STATION.

The station has become very popular among people in this portion of the State, a most substantial proof of which is the fact that after its establishment by the State fishery commission it was feared that it would

have to be closed for lack of funds, and several gentlemen offered to contribute to its support until such time as the State might furnish the funds to carry it on. Upon presenting this matter to the consideration of Mr. E. G. Blackford, of the Board of Fish Commissioners, it was decided not to call upon private aid unless it became absolutely necessary, which fortunately it did not. In addition to the use of land and buildings given by Mr. John D. Jones and his brothers, Townsend, Samuel, and W. E. Jones, Mr. Townsend Jones has given the stone for the great wall of the salt-water pond. This stone is brought from the brown-stone quarries of Connecticut, and is in large blocks, making a solid wall. Mr. Jones sent three schooners for this stone, and each brought about 200 tons. The actual cost of this I do not know, but it cannot be far from \$1,500. Messrs. John D. and Townsend Jones have built a large and handsome house near the hatchery for my use. It has hot and cold water and gas throughout, and has spacious grounds. Dr. O. L. Jones paid \$64.80 for drain-pipe to lead the water from his pond on the hill into the brick hatchery, thereby giving us an additional supply of water for both the hatchery and the ponds. Mr. E. R. Wilbur, of Forest and Stream, gave a water telescope, to be used in examining the bottom of ponds.

THE SALT-WATER DEPARTMENT.

This portion of the work has been done entirely by the State, assisted by the Messrs. Jones. On October 10, 1883, the Board of State Commissioners approved the plans for introducing salt water and ordered the work to begin. Mr. Townsend Jones, in addition to promising to give the stone necessary for the sea-wall, also agreed to have the last of it on the ground within sixty days, which was done. It was decided to build this wall so as to inclose two sides of a pond, the beach forming the other two, and by placing a floodgate in it the water would be retained at low tide and it would not only be available for a place to store valuable native or foreign fishes, but would serve as a reservoir from which to pump. I had previously gone over the upper end of the harbor very carefully with a hydrometer and had tested the water in different parts at flood-tide and found that the water was saltiest at this point. The scale of the hydrometer is so graduated that when placed in distilled water it stands at 1. At a temperature of 62° Fahrenheit sea-water in mid-ocean raises the scale to 1.028, and at the point where our floodgate is placed the density varies from 1.019 to 1.022, and cod-fish have been hatched, I am informed, with a density of 1.010. From this pond 800 feet of 5-inch drain-tile bring the water within 150 feet of the hatchery, where it is pumped by a 6-inch cylinder "Rider" hot-air compression engine into a reservoir on the hill, whence pipes bring it to the house. This engine runs with the consumption of only an ordinary scuttleful of coal in ten hours, and it is claimed will pump 1,000 gallons an hour to a height of 50 feet. It runs very satisfactorily, and

we shall need to run it only about six hours per day when we are using the water.

The large pond was found to require banking outside the wall as well as inside, for the seas went through it and cut out the inside embankment. In this place we were fortunate in not striking springs of fresh water, which are common all along the beach, but we found great trouble from this cause, and also from quicksands, in laying the drain-tile. The winter of 1883 closed in early and we were compelled to suspend out-door labor and to defer until spring the completion of the great tidal reservoir, but we were enabled to hold the water as high as half tide and to begin work. The hot-air engine worked very well, and we hatched the eggs of some fish which laid them in clusters on the sea-weed and which the fishermen all erroneously declared to be those of the little tom-cod (*Microgadus tomcodus*), locally known as "frost-fish" in the fall of the year, and as tom-cod in the spring. I sent some of these eggs to Prof. J. A. Ryder, at the central hatching station of the United States Fish Commission, and he hatched them in artificial sea-water. The spawning season of this unknown fish is in November and December, and they had finished spawning before our engine was in position, but we gathered the eggs from the seaweed, to which they are attached in bunches the size of a hen's egg, and are easily obtained by the oystermen when raking for oysters. What the eggs were I will not attempt to guess, but the following year, 1884, we took the eggs of the tom-cod from the fish and found them free and heavy, and the appearance of the embryo differed from the unknown eggs.

In the winter of 1883-'84 we obtained several million codfish eggs from the cars at Fulton Market, but none of them were good. They showed the shrunk vitellus which gives both them and shad eggs a "speckled" appearance, which indicates that there is no possibility of impregnating such eggs. In every case the parent fish had been brought in the well of a fishing smack, and after being dipped out had been thrown into the floating car alongside, falling from 4 to 6 feet, usually on the abdomen. This, in my opinion, is more than the delicate cod egg can stand. The membrane, or shell, covering the egg of the codfish, is so delicate that a light touch of the finger, when the egg is on any hard substance, will burst it like a soap-bubble, while a trout's egg will bear the hardest squeeze that can be given between the finger and thumb. In December, 1884, we obtained one lot of eggs from the same place, which floated and appeared good when taken, but were dead and at the bottom of the jars on arriving at the hatchery. Later the fish came in dead and we have never had good cod eggs in the hatchery. In November, 1884, I visited Wood's Holl and saw the apparatus devised by Capt. H. C. Chester, and on my return made a similar one of zinc instead of wood. I used a big wooden tank 12 feet long by 6 feet wide and 3 feet deep. The hatcher was merely an elliptical piece of zinc, 5 feet 8 inches long by 2 feet wide, without bottom, and

resting on legs which kept it 2 inches off the floor of the tank, the top of the hatcher being above the water-line. In this were inserted three pieces of rubber tubing, so arranged as to give a continuous movement to the water around the tank in one direction, the good eggs to be kept floating and the bad ones sinking. This was a copy of Captain Chester's arrangement, made a trifle deeper, and of zinc. I also obtained a pork barrel and put a brass cock in the bottom, to which was attached a rubber tube, which, by raising or lowering, regulated the height of water in the barrel, or drew it off entirely. A rubber tube from the supply pipe above dropped into the barrel and delivered the water with a slight inclination upward and around it. So far no opportunity has offered to test these hatchers. At present it is proposed to send a smack load of live cod to be kept here in cars until ripe. If this is done early next season, before the harbor freezes, no doubt many good eggs may be obtained. I never saw codfish eggs float until I saw them do so at Wood's Holl, but early in December, 1884, my assistant, Mr. F. A. Walters, obtained eggs at Fulton Market which floated in water taken from Cold Spring Harbor. These are referred to above. At the meeting of the American Fish-Cultural Association, in Washington, in May, 1884, in reply to a question from Mr. E. G. Blackford, Prof. John A. Ryder said:

"My experience with codfish eggs, both at Fulton Market and at Wood's Holl, has been quite extensive. Our greatest success in handling these eggs has been in comparatively salt water, as Colonel McDonald can testify. The eggs taken at Wood's Holl were from fish that had been kept under the same conditions as those in Fulton Market. At the former place the eggs would float as they should normally, but at Fulton Market they had no tendency to float as did the eggs from the more northern locality. I also observed that in most cases the eggs had an abnormal appearance. The vitellus was disorganized, and the vitelline matter and germinal material were pulled out of shape. The germinal disk was formed, but defectively; in many instances, after formation, it had been broken into irregular fragments, which were certainly not characteristic of normal segmentation. What the cause was I cannot say, but I believe that the confinement of parent female fish of any species would have a tendency to interfere with the fertility of the ova. That has been the experience at Havre de Grace with the shad, and I should not be surprised if the confinement of female cod in the wells of the fishing smacks and in the cars would tend to cause the eggs which were mature and still contained in the ovaries, to become, to a certain extent, disorganized and therefore incapable of fertilization. My conclusions have been formed deliberately, although the data have been very imperfect. There was this important difference between the eggs taken at Wood's Holl and Fulton Market. The latter exhibited a decided tendency to sink, which in our Wood's Holl experiment we always associated with a condition indicating that

such eggs would never hatch. We invariably noticed this to be the case, and concluded to accept it as *prima facie* evidence that whenever a cod egg went to the bottom, that was the last of it, so far as its capacity for development was concerned."

To this I replied: "I have observed that the codfish eggs which I have taken at Fulton Market, New York, had a tendency to sink, as just stated by Professor Ryder. When I removed them from the pan into a jar, the same thing occurred, and you could see the upper line of the eggs about half way up the jar. When placed in the McDonald hatching jars, they acted like whitefish eggs, except that they were a little lighter. The moment the circulation of the water stopped they all sunk to the bottom. I confess to having been somewhat skeptical about 'floating eggs' of codfish, although I understand from Professor Ryder and Colonel McDonald, that at Gloucester the eggs actually floated on the surface, resembling in appearance a honey-comb, and that they were so buoyant that a portion of the egg would literally stand out of the water. I attributed the failure to impregnate the eggs taken at Fulton Market to the shock which the fish suffers by being thrown into the cars from the fishing smacks. They are cast from the deck to the surface of the water, a distance of from 4 to 6 feet, and usually strike on their bellies. The cod egg is exceedingly delicate, and breaks like a soap-bubble at a touch."

Colonel McDonald then said: "The fish from which the eggs at Wood's Holl were taken, were, as far as I know, handled very carefully, being transferred from the smack to the car with as little violence as possible. But may not the difference in the results of the observations made at Wood's Holl and Fulton Market, be explained by a difference in the density of the water at the two places? Of course the buoyancy of the cod egg depends upon the density of the water in which it is placed. Now at Wood's Holl, where the water opens out to the ocean, it surely must be much more dense than at New York Harbor, and the effect of this difference upon the eggs is clearly proved by the fact that those eggs which floated at Wood's Holl sunk at New York. In regard to the eggs taken at New York, they were sent on in hermetically sealed jars to Washington, where on arrival they were found to be impregnated and a small proportion developing. They were then put into salt water artificially prepared (5 ounces of salt to the gallon of water). Development went on, I think, for fifteen or sixteen days, until the embryo was moving and the heart beating, and yet after all we did not succeed in hatching them. Up to that time their development, I believe, was normal. The embryological investigations were carried on by Professor Ryder, who, perhaps, will add a few words."

Prof. Ryder remarked: "You do not mean to say that all the eggs taken were fertile, but that the greater portion of them were. There were large quantities that I know would come to nothing. The vitel-

lus had turned to a brownish hue, and the germinal disk was disorganized."

When the water is full of fine ice or snow "mush," the codfish in the wells of the smacks die freely and their stomachs are found filled with the chilling material, notwithstanding the fact that they are winter spawners and come to the shores of Long Island in winter, where large numbers are taken at that time. In the summer months, when the Gulf Stream is some 200 miles nearer our coast, no codfish are ever found about the bays or harbors of the island. We now propose to bring a smack load of cod here and confine them until they spawn.

Distribution of Penobscot salmon from Cold Spring Harbor in May, 1883, on account of the U. S. Fish Commission.

Date.	Fish supplied.	Loss in transportation.	Fish planted.	Stream.	Tributary of—	Messenger.
May 10	50,000	200	49,800	Carr's Brook ...	Hudson	F. A. Walters.
May 11	5,000	.....	5,000	Of J. D. Jones ..	Great South Bay ..	Long Island Railroad Express Company.
May 14	50,000	300	49,700	Balm of Gilead ..	Hudson	F. A. Walters.
May 17	45,000	800	44,200	Salmon River ...	Lake Ontario	O. B. Hewitt.
May 22	40,000	1,000	39,000	Raymond	Hudson	O. B. Hewitt.
May 23	40,000	100	39,900	Beaver Meadow ..	Hudson	F. A. Walters.
May 24	40,000	500	39,500	Roaring Brook ..	Hudson	O. B. Hewitt.
May 28 ...	40,000	*12,100	27,900	Roaring Brook ..	Hudson	O. B. Hewitt.
Total ..	310,000	15,000	295,000			

*This loss was attributed by Mr. Hewitt partly to a lack of ice and partly to the length of time they had remained in the troughs, which predisposed them to die.

Distribution of Penobscot salmon from Cold Spring Harbor in 1884, on account of the U. S. Fish Commission.

Date.	Fish supplied.	Loss in transportation.	Fish planted.	Stream.	Tributary of—	Messenger.
April 30 ...	40,000	1,200	38,800	Roaring Brook ..	Hudson	F. A. Walters.
May 1	40,000	2,000	38,000	Raymond	Hudson	C. F. Warren.
May 6	40,000	1,000	39,000	Balm of Gilead ..	Hudson	C. F. Warren.
May 7	40,000	800	39,200	Carr's Brook	Hudson	F. A. Walters.
May 9	40,000	1,000	39,000	Glen	Hudson	C. F. Warren.
May 12	40,000	1,400	38,600	Loon Lake	Hudson	C. F. Warren.
May 14	40,000	2,500	37,500	.....	Salmon River	C. F. Warren.
May 19	45,000	4,000	41,000	Clendon	Hudson	C. F. Warren.
May 21	40,000	1,100	38,900	North Creek	Hudson	C. F. Warren.
May 22 ...	5,000	.....	5,000	Cold Spring Har- bor	Long Island Sound.	Fred Mather.
May 26 ...	40,000	8,000	32,000	Kelso	Hudson	C. F. Warren.
May 27 ...	88,700	2,500	86,200	Indian River ...	Hudson	F. A. Walters.
Total ..	448,700	20,500	428,200			

Distribution of landlocked salmon from Cold Spring Harbor in May and June, 1883.

Date.	No. of fish.	Where planted.	By whose order.	Person in charge.	
May	3	3, 500	Mill pond, Cold Spring Harbor	E. G. Blackford	Fred Mather.
	3	40, 000	Lakes of Fulton chain	R. U. Sherman	John Bruckerhoff.
	7	5, 000	Great pond, Montauk Point	E. G. Blackford	Long Island R. R. Co.'s Express.
	16	20, 000	10,000 Woodhull Lake; 10,000 Black River, South Lake.	R. U. Sherman	Frank Hall.
June	25	2, 500	Mill pond, Cold Spring Harbor	E. G. Blackford	Fred Mather.
	11	5, 000	Greenwood Lake, Orange County, N. Y.	S. F. Baird	Fred Mather.
	13	5, 000	South Side Club, of Long Island	S. F. Baird	F. A. Walters.
	13	4, 000	Ponds near Sayville, Suffolk County....	R. B. Roosevelt	F. A. Walters.
Total ..	85, 000				

Distribution of landlocked salmon from Cold Spring Harbor in 1884.

	Number.
Eggs sent to the Bisby Club, Oneida County, N. Y.	31, 000
Eggs hatched at Cold Spring Harbor, N. Y.	10, 500
	41, 500
Fry deposited in ponds of Townsend Jones, and of hatchery	8, 500

Distribution of whitefish from Cold Spring Harbor, March, 1883.

Date.	No. of fish.	Where planted.	Messenger.
Mar. 20 24	40, 000	Mill Pond, Cold Spring Harbor *	Fred Mather.
	500, 000	Great Pond, near Riverhead, Long Island †	F. A. Walters.

* This pond is only 18 feet deep, and I have no confidence in their living here. Our kind landlord wished to try the experiment.

† Great Pond is 70 feet deep in places, and the fish may thrive.

Distribution of whitefish from Cold Spring Harbor, 1884.

Date.	No. of fish.	Where planted.	Messenger.
Feb. 15	400, 000	Great Pond, Long Island	F. A. Walters.
Mar. 6	75, 000	Saint John's Lake, Long Island	Fred Mather.
10	375, 000	Lake Ronkonkoma, Long Island	F. A. Walters.

Distribution of shad from Cold Spring Harbor, 1884.

Date.	No. of fish.	Where planted.	Person in charge.
May 20	72, 000	Nissequague River	Walter S. Stoots.

Distribution of brook trout from Cold Spring Harbor in April and May, 1883.

Date.	No. of fish.	Delivered to—	Post office address.	For what streams.	On account of—
Apr. 25	5,000	J. F. Sutton.....	Bedford Station, Harlem Railroad.	.....	N. Y. Fish Com.
May 3	5,000	Townsend Jones..	Cold Spring Harbor.	Mill Pond Brook...	U. S. Fish Com.
4	10,000	John Cashow.....	Locust Valley.....	Shoe Swamp Brook...	N. Y. Fish Com.
8	5,000	W. H. O'Donnell...	Daily News, 25 Park Row, New York.	Brooks, near Peek- kill.	N. Y. Fish Com.
9	10,000	R. S. McCracken...	Hackettstown, N. J.	Musconetcong, N. J.	U. S. Fish Com.
11	10,000	W. Holberton.....	Hackensack, N. J.	Cedar Creek and New- bridge Creek, near Merrick, L. I.	N. Y. Fish Com.
11	5,000	John D. Jones....	91 Wallstreet, New York.	South side of Long Island.	U. S. Fish Com.
17	8,000	N. W. Foster.....	Riverhead, N. Y....	Near Riverhead, L. I.	N. Y. Fish Com.
25	3,000	Townsend Jones..	Cold Spring Harbor.	Mill Pond Brook....	U. S. Fish Com.
	1,000	Kept at hatchery.			
Total..	62,000				

Distribution of brook trout from Cold Spring Harbor in 1884.

[Eggs received, 6,000.]

Date.	No. of fish.	Delivered to—	Post-office address.	For what streams.	On account of—
April 20	1,000	John Cashow..	Locust Valley, N. Y.	Shoe Swamp Brook...	N. Y. Fish Com.
23	4,000	Townsend Jones..	Cold Spring Harbor.	Saint John's Lake....	U. S. Fish Com.

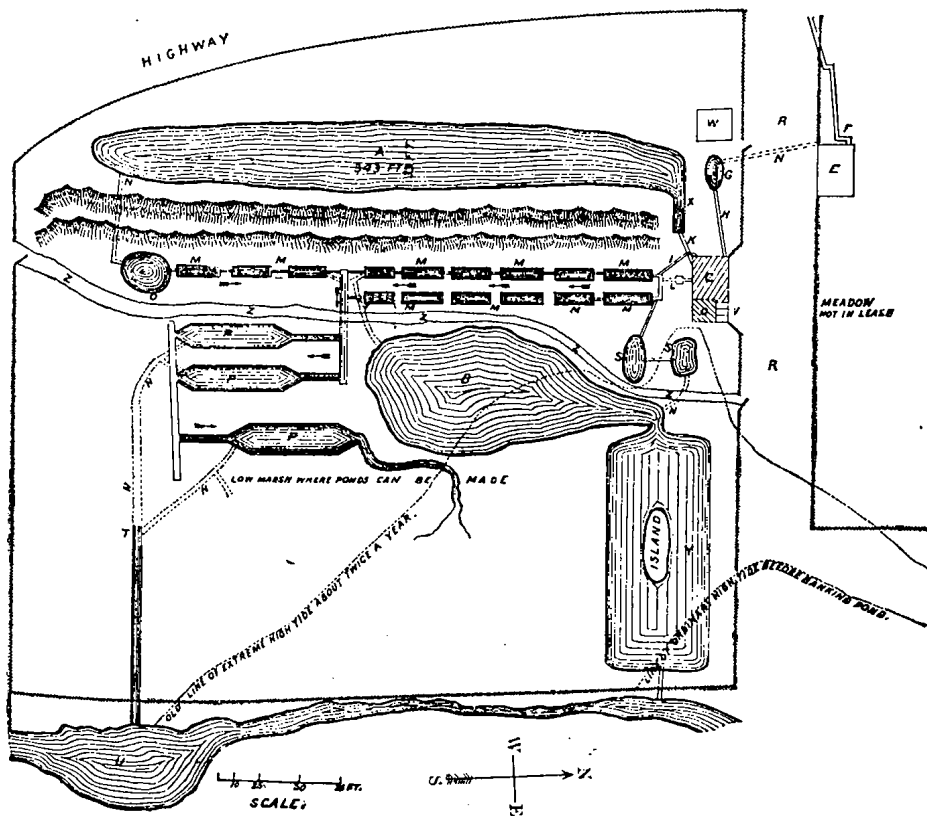
Distribution of rainbow trout from Cold Spring Harbor, July, 1883.

Date.	No. of fish.	Delivered to—	Post-office address.	For what streams.	On account of—
July 4	1,200	F. S. Weeks.....	Cold Spring Harbor.	Below beach.....	N. Y. Fish Com.
	2,000	J. Reynal.....	84 White street, N. Y.	Westchester Co.....	N. Y. Fish Com.
	5,000	South Side Club...	Oakdale, Suffolk Co.	On grounds.....	U. S. Fish Com.
	5,000	S. L. M. Barlow...	1 Madison ave., N. Y.	Near Montauk.....	N. Y. Fish Com.
	1,000	Kept at hatchery...			
	*12,000				
	26,200				

* Escaped from troughs into harbor.

Distribution of rainbow trout from Cold Spring Harbor in 1884.

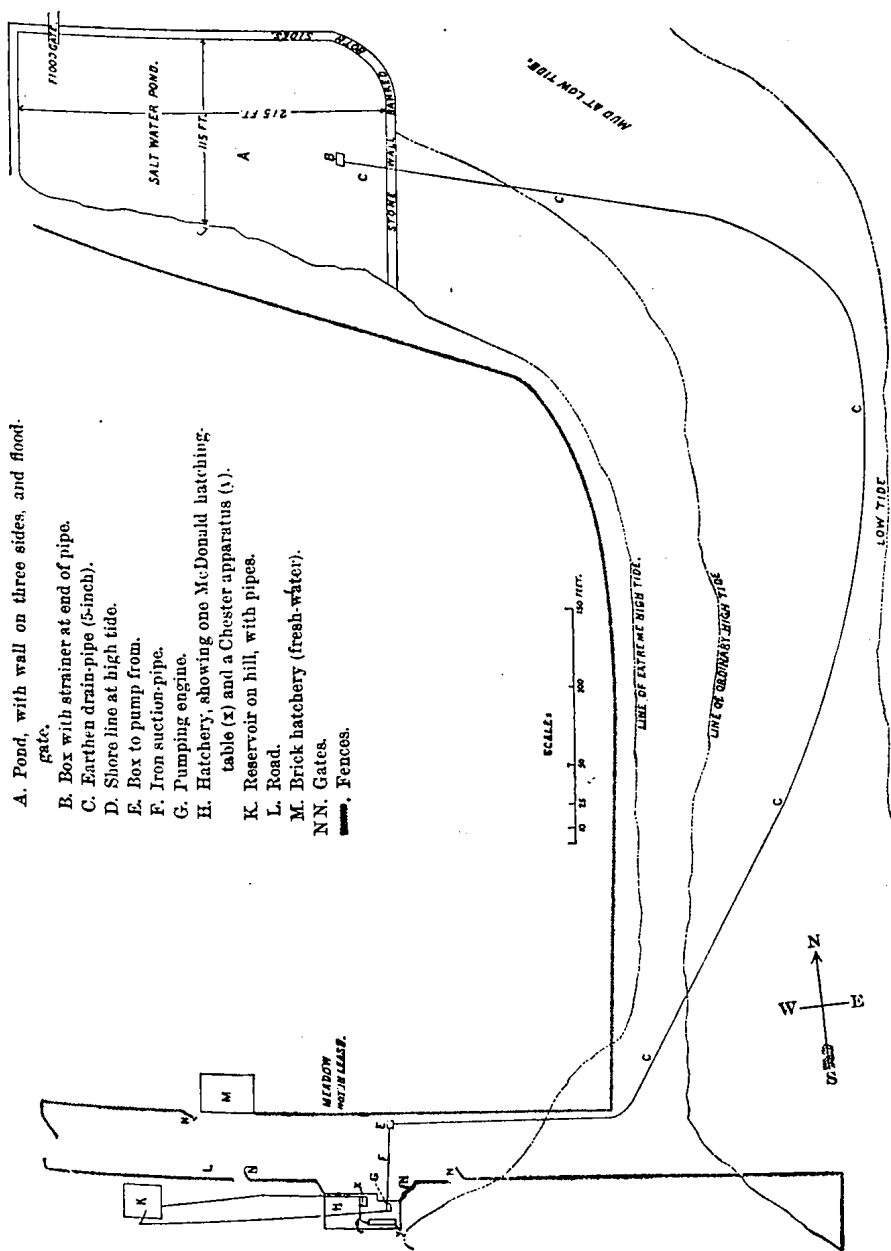
Date.	No. of fish.	Delivered to—	Post-office address.	For streams.	On account of—
April 23	6,000	Townsend Jones..	Cold Spring Harbor.	Mill ponds.....	U. S. Fish Com.
May 15	4,000	F. S. Weeks.....	...do.....	Below beach.....	U. S. Fish Com.



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|-----------------------------------------------|------------------------------------------------------------|
| A. Spring reservoir. | O. Pond in earth supplied from A. |
| B. An old pond on low ground. | PP. Ponds for older fish. |
| C. Two-story hatchery (old mill). | R. Highway, unused at present. |
| D. Salt-water hatchery and engine-house. | SS. Ponds in earth. |
| E. Brick hatchery on hill. | T. Outlet ditch. |
| F. Filter, with pipe from a spring not shown. | U. Outlet of mill-ponds above, not connected with grounds. |
| G. Settling reservoir receiving water from E. | V. Coal and wood bins. |
| H. Supply-pipe to 2d story of old hatchery. | W. Salt-water reservoir. |
| I. Waste-pipe from 2d story of old hatchery. | X. Flume belonging to old mill, C. |
| K. Supply-pipe to lower floor. | Y. Pond, made with sod-wall and island. |
| L. Waste-pipe from lower floor. | Z. Wagon-road. |
| MM. Rearing ponds, 25 by 6 feet, of boards. | |
| NN. Underground drains. | |

SPRINGS. Fences.

MAP OF FRESH-WATER DEPARTMENT.



MAP OF SALT-WATER DEPARTMENT.