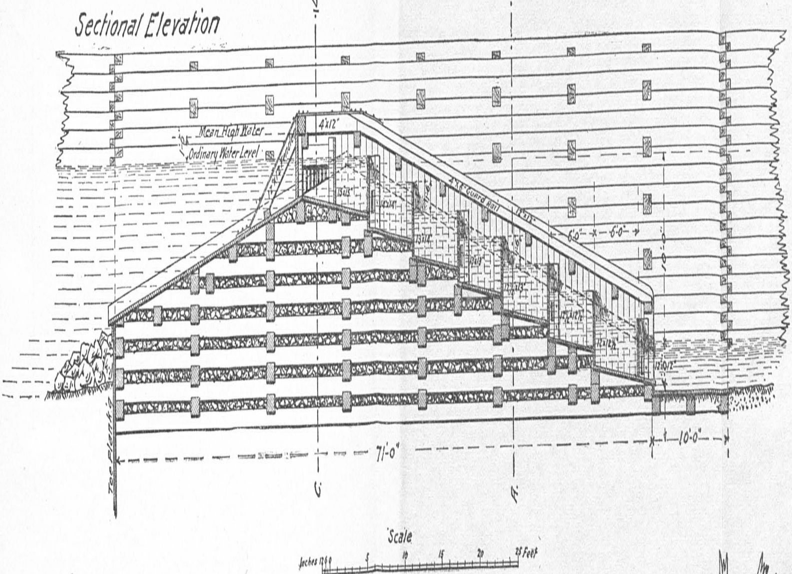
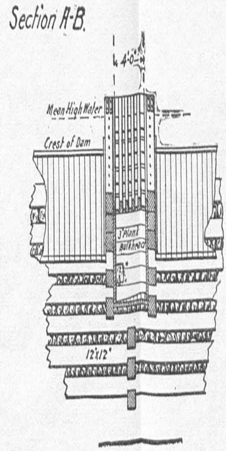
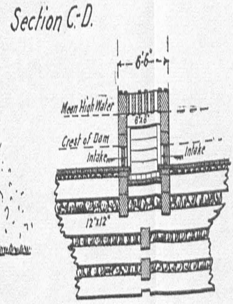
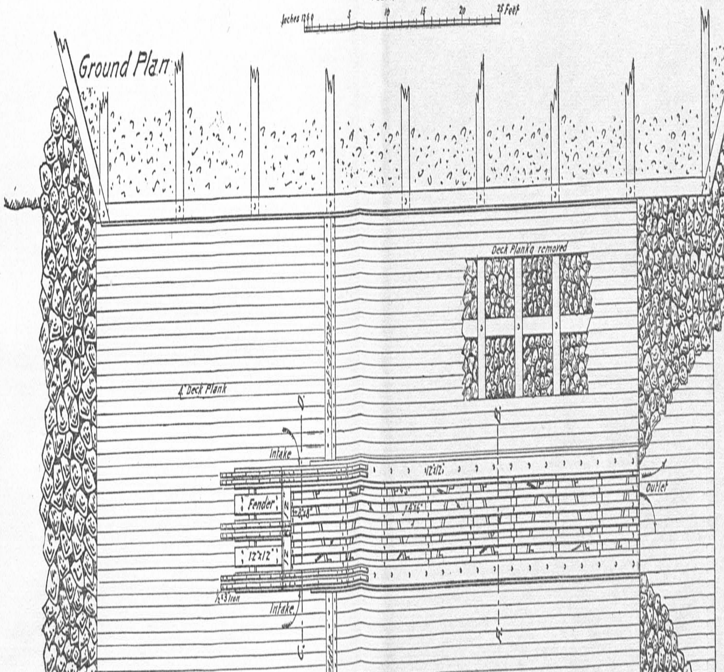








DIRECTIONS.

Slope of fishway should not be steeper than on a ratio of 1 vertical to 4 horizontal.

Intake, or up-stream end of fishway, should be amply large and placed not less than 1 foot lower than crest of dam.

Outlet should be below low-water level and so located or constructed that fish are naturally led to it when ascending the stream.

There should be relatively deep water, with an unobstructed flow below the outlet of the fishway. An ample discharge of water should attract the fish to the outlet.

There should be plenty of light admitted in the fishway, and its construction should be such as to be readily inspected and cleaned of any débris lodging therein.

The floor of the compartments should be laid slightly inclined and the bulkheads somewhat obliquely across the fishway, so that the current of water passing through the compartments can more readily clear the same of sand, gravel, mud, and rubbish.

There should be no regulating gates or other devices at the intake which necessitate the services of an attendant.

The apertures in the bulkheads should increase progressively from the lower to the upper ones, to insure overflow from compartment to compartment.

The flow of water should be abundant, forming small waterfalls over the bulkheads, so that the fish may either jump from one compartment to the next above or may dart through the apertures in the bulkheads.

While the flow of water through the apertures may reach a velocity of 10 feet per second, there will be relatively quiet water in the compartments, thus furnishing a resting place for the ascending fish.

To maintain the operation of the fishway at an average high water the same as at the ordinary stage of the stream or river, the uppermost compartment is made somewhat longer, and a central bulkhead is inserted having its crest at high-water level.

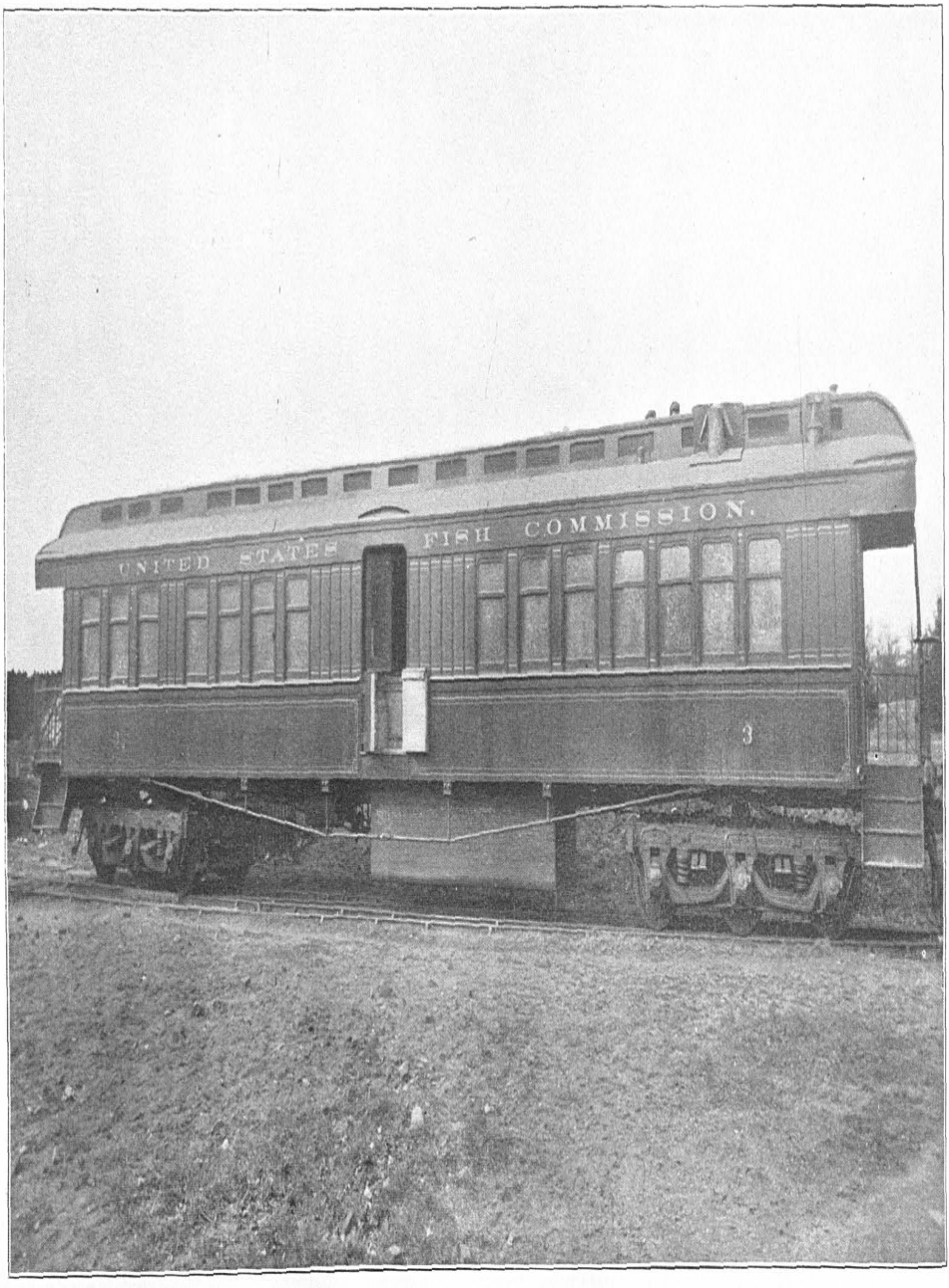
The fishway may be constructed of wood or masonry and iron; it may follow a straight line or be built in angles and curves, as the local conditions may require.

The size of the fishway depends principally on the volume of water available, and can be made larger or smaller than that shown on plan. The hydranlic head between two successive compartments must be so chosen as to obtain a current velocity through the apertures of not to exceed 10 feet per second. At low-water stage of the stream or river, with the fishway flowing full, there should be a liberal discharge over the crest of the dam.

The fishwav should be built very strong and be well protected against the destructive effects of freshets, drift ice, etc.

H. v. B. del.

FISHWAY—IMPROVED CAIL SYSTEM.



CAR NO. 3—EXTERIOR.

REPORT ON THE PROPAGATION AND DISTRIBUTION OF FOOD-FISHES.

By W. DE C. RAVENEL, *Assistant in Charge.*

INTRODUCTION.

The operations of the Division of Fish-culture during the fiscal year were more extensive and important than ever before. The number of eggs, fry, and adult fish distributed was 857,509,546, the majority of which represent the important commercial species, such as the cod, shad, whitefish, quinnat salmon, lake trout, herring, pike perch, and lobsters.

Following the general lines adopted the previous year, the propagation of the quinnat salmon, the most important of the Pacific coast fishes, was conducted not only at Battle Creek and Baird, in the Sacramento River Valley, and on the Clackamas, Salmon, and Little White Salmon rivers, tributaries of the Columbia, but a temporary station was established and operated on the Rogue River and the hatchery on the Siuslaw River was reopened. Arrangements were also perfected to collect salmon eggs at the headwaters of the Clackamas River, where the spawning-beds of the early run of fish entering that stream in April and May are found. The results at the Battle Creek and Little White Salmon stations were even better than had been anticipated, over 62,000,000 eggs being taken at the two points. The fish resulting from the collections made at all of the stations were liberated in streams on the Pacific coast, with the exception of 6,000,000, which were transferred to eastern stations to continue the experiment of acclimatizing the quinnat salmon in the coastal streams of the Atlantic Ocean.

Encouraged by reports of the capture of steelhead trout in tributaries of the Great Lakes, as a result of plants made by this Commission two years ago, 750,000 eggs of this species were sent to stations on the lakes and in New England for deposit in suitable waters.

Some experimental work was undertaken at Put-in Bay in penning and holding adult whitefish until ready to deposit their eggs, with the view to increasing the collections on Lake Erie, so as to supply the hatcheries at Duluth, Alpena, and Cape Vincent. The results, though not large, show that by similar methods good returns may be expected, and under favorable conditions the number of eggs collected in the future will be limited only by the number of whitefish taken during the fall months, whereas, under the present system, a storm occurring during the short spawning season reduces the collections from 30 to 50

per cent. The expansion of this work on Lake Erie is essential if the hatcheries on the Upper Lakes are to be kept open, as the collection of eggs on Lakes Huron and Michigan is now impracticable on account of the recent act passed by the Michigan legislature forbidding the capture of whitefish from November 1 to December 15, which covers almost the entire spawning period of that species. For the reason stated above, the whitefish and lake-herring work was confined to Put-in Bay Station.

The collection of lake-trout eggs at Duluth and Northville was larger than usual, notwithstanding the fact that the passage of the act referred to above prevented the collection of eggs at many of the most important fishing points on Lake Michigan. The field of operations was extended into Georgian Bay, where large numbers of eggs were secured, and to the eastern end of Lake Superior, where the fishermen had heretofore furnished eggs to the Michigan Fish Commission.

The resumption of pike-perch work on Lake Erie, after a lapse of two years, resulted in the collection of 221,000,000 eggs and the liberation of 81,153,000 fry in the waters of Lakes Erie and Ontario.

The propagation of marine species was commenced early in the fall at Woods Hole and Gloucester, Mass., on the plan heretofore followed, except that an additional field station for the collection of cod eggs was established at Plymouth, Mass., and the number of brood-fish held at Woods Hole Station was materially reduced. The results attained by these changes were exceedingly satisfactory, over 300,000,000 eggs being handled at the two stations, which resulted in the liberation of 203,000,000 fry on the spawning-grounds along the New England coast.

Considerable attention was also paid to the propagation of flatfish during the months of February and March, but, owing to presence of ice until after the spawning season was partially over in Waquoit Bay, the number of eggs collected was not so large as had been anticipated.

Notwithstanding the decline in the lobster fishery and other unfavorable conditions, over 60,000,000 eggs were taken on the coasts of Maine and Massachusetts north of Cape Cod. South of the cape and along the coasts of Connecticut and Rhode Island, however, the results were unsatisfactory, due not only to a decided decrease in the fishery, but to the fact that little or no fishing was being done in the vicinity of Woods Hole Station, where large numbers of eggs are ordinarily collected. This was partly attributed to the passage of a law by the State of Massachusetts forbidding pound or trap-net fishing in Buzzards Bay, from which source all of the bait used by the lobster fishermen had been derived.

The shad work was the largest ever accomplished by the Commission, more than 300,000,000 eggs being taken on the Susquehanna, Delaware, and Potomac rivers and Albemarle Sound. The steamer *Fish Hawk*, detailed during the winter for shad work in southern waters, was used as a floating hatchery at Avoca, N. C., on the Chowan River, at the head of Albemarle Sound. Previous to commencing this work she

was employed in making an investigation of the Edisto River, South Carolina, to determine the advisability of establishing an auxiliary station for the propagation of shad on that stream, but the information gained was not favorable.

Operations on the Delaware and Potomac rivers were materially interfered with by causes pertaining to the war with Spain; on the Delaware by the withdrawal of the *Fish Hawk* for naval duty at the very height of the spawning season, and on the Potomac by the establishment of a blockade at Fort Washington and by the laying of mines or torpedoes on the spawning-grounds.

In order that the shad work on the Delaware might not be omitted altogether, arrangements were made with the Pennsylvania Fish Commission for the use of their shad-hatchery at Bristol, which permitted the hatching and planting of 21,000,000 fry in this stream and its tributaries. At Battery Station, on the Susquehanna, the results were very satisfactory, over 209,000,000 eggs being secured between April 13 and June 10, about 100 per cent more than had ever been taken at any of the stations of the Commission during a single season.

At the trout and bass stations the work was generally satisfactory, the production of brook trout being much larger than ever before. The number of bass distributed was small as compared with other fishes, but it is believed, with the experience gained during the past season, that the output from the various stations will be largely increased next season. Considerable attention has also been paid to the propagation of the crappie, one of the most desirable fishes for stocking the streams and lakes in the Mississippi and Missouri River valleys, and in the South and Southwest.

In addition to the fishes heretofore handled, the propagation of the Montana grayling was taken up at Bozeman Station; about 3,000,000 eggs were collected at Red Rock, Montana, at the headwaters of the Jefferson River. Efforts have been made in past years by the United States Fish Commission and the various State fish commissions to collect eggs of this valuable game and food fish, but the results heretofore attained have been very unsatisfactory.

Continuing the experiments of previous years, two consignments of adult lobsters were sent from Woods Hole to San Francisco during the months of July and December and liberated near the Farallone Islands. Of these, 229 were females, carrying from 10,000 to 25,000 eggs each, so that it is estimated that from 3,000,000 to 4,000,000 young lobsters resulted from this plant, in addition to the adults.

In July a carload of tautog and blue crabs was also sent west for introduction into the waters of the Pacific, as it was thought they would not only be well adapted to the waters of the Pacific Coast, but would prove valuable additions to the fishery resources of that section. The plants were made near the Farallone Islands during July, and consisted of 566 fish ranging in length from 4 to 10 inches, and 162 of the common blue crab of the Atlantic Coast.

SPECIAL INVESTIGATIONS AND INSPECTION.

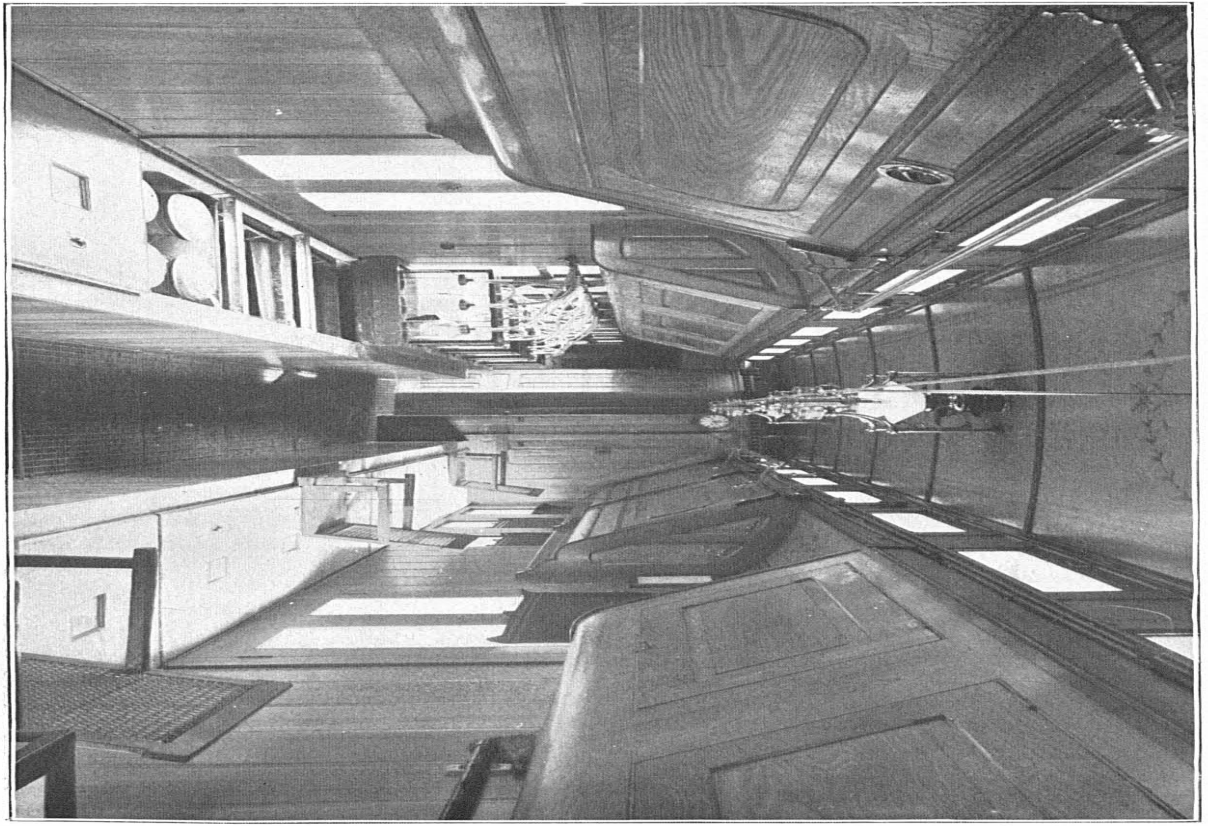
During the month of August the assistant in charge inspected the stations of the Commission in Michigan, Minnesota, Montana, Colorado, Missouri, and Illinois. Advantage was taken of the opportunity to confer with the superintendents regarding the conduct of the work and the possibilities of its extension. The general condition of affairs at all of the stations was satisfactory, and discipline, on the whole, was found to be well maintained. The buildings and grounds at most of the stations were in only fair condition, and in order to maintain and render them attractive to the public special appropriations are needed for most of them, as indicated in recommendations submitted with detailed report of inspection. An appropriation for improvements at the Leadville Station is particularly important, as an additional supply of water is needed, and in order to obtain the best results it will be necessary to provide some system for draining the Evergreen Lakes during the fall, so as to handle the brood-fish. The buildings at this station are in excellent condition, but the grounds are overgrown with brush and prairie grass, and as it is quite a popular resort for the residents of Leadville, it should be completed. This could be done at comparatively small expense. The general condition of the station at Neosho, Mo., was worse than any of the others. The ponds were much in need of repair, and the water supply is inadequate.

In December a preliminary survey of the Edisto River, South Carolina, was made to determine as to the practicability of establishing an auxiliary station for the propagation of shad, and as a result the *Fish Hawk* was detailed in March to visit that stream and undertake the collection of eggs. During April several trips were made to the shad stations on the Potomac and Susquehanna rivers, and in May to the Delaware River, for the purpose of conferring with Mr. W. E. Meehan, of the Pennsylvania Fish Commission, and the commanding officer of the steamer *Fish Hawk*, relative to conduct of shad work at the Bristol hatchery in the event of the *Fish Hawk* not being available for work in this vicinity. Visits were also made in May to Massachusetts, to arrange for lobster collections at Gloucester and Woods Hole.

During the spring of 1898 the superintendent of the Cape Vincent Station investigated the sturgeon fisheries of Lakes Erie and Ontario with the view to taking up the propagation of this species, but no locality was found where spawning fish could be obtained in sufficient numbers to warrant the establishment of an auxiliary station for this purpose.

CAR AND MESSENGER SERVICE.

Owing to the necessity for rebuilding cars Nos. 1 and 2 and the large amount of routine work necessitated by the increased output of fish during the fiscal year, this service has been taxed to its utmost capacity, and it was found necessary to hire baggage and express cars from the railroads on several occasions to assist in making the distribution in Virginia and Michigan. Besides the routine work, one of the



CAR NO. 3—INTERIOR.

cars was used during the first four months of the fiscal year in making collections of marine and fresh-water fishes and transporting the same to the Tennessee Centennial Exposition at Nashville, Tenn., and again during the months of May and June, 1898, in transferring salt-water specimens from Woods Hole, Mass., to Omaha, and fresh-water fishes from Quincy, Ill., and other points in the Mississippi Valley.

Car No. 3 also made two trips from Woods Hole to San Francisco with lobsters, tautogs, and blue crabs, the first in July and the last in December. On the return trip of the car in July 350 giant crabs were brought from the Pacific Coast and planted in Pagan Creek, a tributary of the Chesapeake Bay. The car left San Francisco July 31 with 1,100 crabs, 600 females and 500 males; 450 were packed in seaweed in the refrigerator compartment under the car, 550 were placed in transportation tanks, in salt water with air circulation, and 100 in crates packed in grass. On August 1, when the crabs were overhauled, all were dead except those in tanks of aerated water; up to this time the temperature had been maintained at 60°; 36 were lost on August 2, 45 on the 3d, 58 on the 4th, and 61 on the 5th; the temperature had risen from 60° to 65°, the average for the period being 62°. Of 350 crabs reaching Newport, Va., 200 were females and 150 males. These were planted, with the cooperation of the officials of the Chesapeake and Ohio Railroad, in Pagan Creek, Isle of Wight County, Virginia. The temperature of the water in which they were liberated was 78°.

Excellent results were attained on the last trip, in December, over 90 per cent of the lobsters reaching the Pacific Coast alive. On previous trips the number reaching the destination in good condition never exceeded 50 per cent, and several times it was as low as 30 per cent. This difference in results is attributed not only to the fact that the trip was made at a season when a low temperature could be maintained, but also to the difference in the methods of transportation. On November 29 the car left Woods Hole with 150 egg-lobsters, packed 5 in a crate, with seaweed. At Boston 98 egg-lobsters and 50 males were taken on and placed in 50-gallon transportation tanks filled with filtered water and constantly supplied with air, 30 being placed in each tank. Those in the crates were taken out every day and dipped into the tanks of salt water and then repacked, the seaweed being sprinkled with salt water twice a day. The loss from December 1 to 5, when the car reached San Francisco, was 27. The average temperature of the water en route was 45°, maximum 50°, and minimum 36°.

The methods followed in handling the fish were practically the same as before, except in the case of the lobsters.

The cars traveled during the year 98,964 miles, of which 63,167 miles were free; detached messengers traveled 121,160 miles, of which 33,346 were free. Every State and Territory in the Union was visited. No accidents of any importance occurred, and the losses of fish were about the same as usual, less than 2 per cent of the total number handled, including the marine species, where the losses usually vary from 40 to 70 per cent on long trips.

On the return of car No. 3 from its last trip to the Pacific Coast it was sent to Tampa, Fla., to remain during the sessions of the Fisheries Congress, from January 19 to 26, for the purpose of illustrating the methods employed in hatching eggs and distributing fishes.

In July car No. 1 was placed in the shops of Jackson & Sharp, and in August car No. 3 in the shops of Harlan & Hollingsworth, Wilmington, Del., and were rebuilt at an expense of about $11,000. They were remodeled on practically the same plan, except that the center doors of car No. 1 do not extend to the floor, as is the case in car No. 3.

The dimensions of car No. 3 as rebuilt are as follows: Length of body, 60 feet; total length from end of platform to end of platform, 67 feet 10 inches; width, 9½ feet; height from top of rail to top of roof, 13 feet 8 inches. The frame of the car is so braced as to permit of the two large doors in the center extending from floor to roof, as shown in plate IV. This feature very materially simplifies loading and unloading. The interior of the car is finished in ash, and in one end is an office, an ice-box of 1½ tons capacity, and a pressure tank holding 500 gallons of water; at the other end are the boiler room and kitchen. The boiler room is equipped with a 5-horsepower boiler, circulating water pump, and air and feed pump. The tanks and cans used in transporting fish are carried in two compartments running along the sides of the car between the office and boiler room. They are 30 feet long, 3 feet wide, and 25 inches deep. Under the car, between the trucks, is a reservoir tank holding 600 gallons of water, and from which water is pumped into the pressure tank near the office; it then passes from this tank to the fish cans and tanks, and then back to the reservoir. In the middle of the car, over the compartments referred to, are four berths and several lockers for the use of the crew. The office also contains two berths, a writing desk, and a typewriter. These cars are fully equipped with all modern improvements in the way of brakes, couplers, signal whistles, etc., and have Pullman trucks and 33-inch Allen paper wheels. With the large water capacity provided, they are capable of carrying much greater loads of fish than ever before.

EXPOSITIONS.

The Tennessee Centennial Exposition, in progress at Nashville at the close of the fiscal year, was terminated October 31, and all material except the aquaria was returned to Washington. During July and August much difficulty was experienced in keeping up the display of fishes in the aquarium on account of the intense heat. During June the temperature of the salt water rose rapidly, and when it reached 78° it became necessary to adopt artificial means to save the fish, notwithstanding the fact that the specimens exhibited were all collected in southern waters, at Morehead City, N. C., and Pensacola, Fla. This was accomplished by passing all the water used through 300 feet of pipe coil, packed in crushed ice and salt. This method proved very expensive, as it required over 1½ tons of ice per day to reduce the temperature below the danger point, that is, 70°.

MAIN ENTRANCE TO AQUARIUM, OMAHA.

Notwithstanding the unfavorable conditions the aquaria were kept fully supplied with most of the commercial fishes of the Gulf and the South Atlantic Ocean, with many of the ornamental species and all of the fishes of the Mississippi Valley, and with a number of *Salmonidæ* propagated by the Commission, such as the brook trout, rainbow trout, steelhead, and quinnat salmon. In September fish-cultural work was taken up, and two consignments of 10,000 salmon eggs shipped from California were hatched. This feature of the exhibit was particularly interesting to the people of that section of the country, as it was the first time that the eggs of any of the *Salmonidæ* had been artificially hatched in Tennessee. This was only rendered possible by the sinking of a well near the Government building, which furnished a steady flow of excellent water at 59° throughout the summer. At the close of the exposition the fishes on hand were planted in suitable waters in the vicinity or transferred to some of the stations of the Commission. The aquaria material, including the machinery, was shipped to Omaha. During the absence of the representative from Nashville the exhibit was at different times under the direction of L. G. Harron, W. P. Sauerhoff, and R. J. Conway. Mr. Conway was in charge at the close of the exposition and attended to the packing and shipping of the exhibit. A report of the part taken by the U. S. Fish Commission in this exposition will be found on pages 329–339 of the appendices to this report.

On July 27 the assistant in charge of the Division of Fish-culture was appointed representative of the United States Fish Commission on the government board of management for the Trans-Mississippi and International Exposition, to be held in the city of Omaha, Nebr., in accordance with act approved June 4, 1897. The board was not organized until September, when the allotment of funds and space was made, the Commission receiving $20,000 and 5,027 square feet of space in the northwest corner of the Government Building. Subsequently all allotments were changed, owing to the passage of a joint resolution by the House and Senate on December 18, the appropriation from the Government exhibit being reduced from $150,000 to $137,500, so that the amount available for the Fish Commission was $18,333.

As the live-fish exhibit at previous expositions had proved the most attractive feature, it was decided to devote $10,000 and 4,000 feet of space to the erection of a suitable aquarium. The plans and specifications for this were prepared by Mr. George A. Schneider, who also superintended its construction.

The aquarium is a grotto-like structure, 140 feet long by 26 feet wide, arranged in the shape of a ⌊‾‾⌋ with arched entrances at the short arms and a rotunda at the turning points. The entrances are semi-circular archways supported on colonnades, embellished with ornamental work, soffit and face, and flanked on each side by wings in a rich pilaster treatment of the renaissance style. An ornamental, semi-circular grille, with the seals of the United States and the State of Nebraska, is inserted in the arch, the top of which terminates in

imitation shellwork, with a youthful Poseidon taming an aquatic monster, over the keystone.

Surmounting the entablature of the wings are two allegorical figures representing fisher-maids catching and planting fish in the waters of the country. The exterior portions of the entrances are finished in imitation ivory and gold. The interior of the grotto is treated in imitation of a roughly blasted rock tunnel, and depending from its roof are numerous stalactites of a pale-greenish hue. The aquaria, of which there are 25, are each 7 feet long, 3 feet high, and 5 feet wide at the top; they extend along the sides of the interior of the grotto, and are decorated inside with rock and aquatic plants, and arranged so that all light entering the grotto first passes through them. Eight of them are used for showing such salt-water fishes as can be obtained off the New England coast near Woods Hole, Mass., and the balance are filled with species indigenous to the Mississippi River and the various fishes propagated by the Commission. In each of the rotundas are large, oval pools so arranged as to be illuminated from below with electric lights.

In the rectangular space formed by the two short arms of the grotto are exhibits of the different phases of the work of the Commission. The methods employed by the Commission in fish-cultural work are practically demonstrated by hatching, in a regulation trough, rainbow and black-spotted trout eggs, shipped by express from Colorado during the month of June. As it is impracticable to secure semi-buoyant eggs, such as shad, whitefish, and pike perch, and floating eggs like the cod, pollock, and flatfish, the methods are illustrated with artificial eggs made of rosin. In addition to practical illustrations, models of the various forms of apparatus used are exhibited, including a model of the trout station at Leadville, Colo. The process of egg-taking is shown by a lay figure of a spawn-taker with a quinnat salmon in his hands in the act of stripping the eggs. The work of distribution is illustrated by photographs, drawings, and a working model of car No. 3, recently reconstructed by Harlan & Hollingsworth. The results of fish-culture and the scope of the work accomplished by the Commission during the fiscal year 1896–97 are shown by large charts and numbers of photographs and drawings.

The scientific functions and work of the Commission are set forth by models and photographs of the exploring vessels *Albatross* and *Fish Hawk*, by an assortment of seines, dredges, nets, and by the deep-sea sounding apparatus used in making collections in fresh and salt water. In this section there is also a full collection of oyster shells, illustrating their sizes at different ages, peculiarities common to various regions, materials used for the attachment of spat, various objects to which young oysters adhere, influence of the bottom on the oyster's growth, and enemies and injuries caused by each. Among the objects of the American fisheries exhibited are the following: Mounted groups of northern fur-seals, Steller's sea lions, casts of cetaceans, 150 casts of food-fishes colored from living or fresh specimens, and painted casts of edible frogs.

GENERAL VIEW OF THE FISH COMMISSION EXHIBIT, OMAHA.

Through the courtesy of Messrs. Tiffany & Company, of New York, a collection of pearls and pearl-bearing mollusks is shown, consisting of specimens of white, pink, brown, copper-colored and fancy-colored pearls, a set of pearl-bearing shells, instruments for opening them, also a water-telescope for finding the mollusks, and illustrations of pearls.

In the fisheries section the various forms of nets, traps, weirs, pound nets, seines, pots, dredges, tongs, etc., used in the capture of fresh-water products are fully shown, also characteristic types of fishing craft employed in the American fisheries, among them the swift New England schooner, the Florida smacker, the Chesapeake Bay oyster pungy, the shad boat of the North Carolina sounds, and the San Francisco market steamer. In addition to these are numerous large photographs, portraying the methods adopted in the important commercial fisheries of the Atlantic, Gulf, and Pacific coasts and the Great Lakes, and a series of crayon pictures illustrating the Alaskan fur-seal fishery. The fisheries of the United States are presented by States on a large chart.

At the opening of the exposition the aquarium contained a large variety of fresh-water and salt-water fishes, together with a number of aquatic invertebrates. The fresh-water fishes comprise brook trout, rainbow trout, black-spotted trout, yellow-fin trout, lake trout, steelhead trout, large-mouth and small-mouth black bass, crappie, strawberry bass, sunfishes, and the characteristic native fishes of the Mississippi Valley, including the largest obtainable specimens of sturgeon, catfish, and paddlefish, several of the catfish weighing 40 pounds and over. Aquatic reptiles are represented by living specimens of mud puppies, terrapin, edible frogs, etc. These large specimens, with a number of ornamental species like goldfish, tench, and golden ide, are displayed in oval pools under the rotundas and prove a most attractive feature. In the salt water tanks about 50 varieties of food, game, and bait fishes of the Atlantic coast are represented by specimens of various ages, including dogfish, skates, sea bass, kingfish, tautog, chogset, sculpin, scup, toadfish, sea robin, pollock, cod, hake, and flounders. Lobsters, crayfish, crabs, and various kinds of mollusks are also exhibited.

As it was impracticable for the representative to remain in Omaha after the opening of the exposition, the Commission is represented by Mr. R. J. Conway, who has charge of the aquarium, and by Mr. W. P. Sauerhoff. Mr. L. G. Harron was detailed from Washington to assist in the installation of the aquarium, and rendered effective service during the opening days of the exposition.

The Commission is much indebted to the Union Tank Line Company, of New York, for the loan of two tank cars for transporting salt water from Woods Hole, Mass., to Omaha; also to the Michigan Central and the Chicago, Milwaukee and St. Paul railroad companies for free transportation, and to the Michigan Central Railroad for the transportation of car No. 4 with salt-water fishes over its line, and to the Missouri Pacific for transporting all the cars of the Commission into the exposition grounds.

STATION OPERATIONS.

The fish-cultural work of the several stations is given in detail in the abstracts from the reports of the superintendents, and embraces the propagation of 26 species of fish and 1 crustacean. The following stations and auxiliary stations were operated during the year:

Green Lake, Maine.
Craig Brook, Maine.
Grand Lake Stream, Maine.
St. Johnsbury, Vermont.
Cape Vincent, New York.
Gloucester, Massachusetts.
Woods Hole, Massachusetts.
Steamer *Fish Hawk* (Albemarle Sound, Edisto River, Delaware River).
Bristol, Pennsylvania.
Battery Station, Maryland.
Bryan Point, Maryland.
Central Station, Washington, D. C.
Fish Ponds, Washington, D. C.
Wytheville, Virginia.
Erwin, Tennessee.
Put-in Bay, Ohio.
Northville, Michigan.
Alpena, Michigan.
Duluth, Minnesota.
Manchester, Iowa.
Quincy, Illinois.
Neosho, Missouri.
San Marcos, Texas.
Leadville, Colorado.
Bozeman, Montana.
Baird, California.
Battle Creek, California.
Fort Gaston, California.
Clackamas, Oregon.
Upper Clackamas, Oregon.
Salmon River, Oregon.
Rogue River, Oregon.
Siuslaw River, Oregon.
Little White Salmon River, Washington.

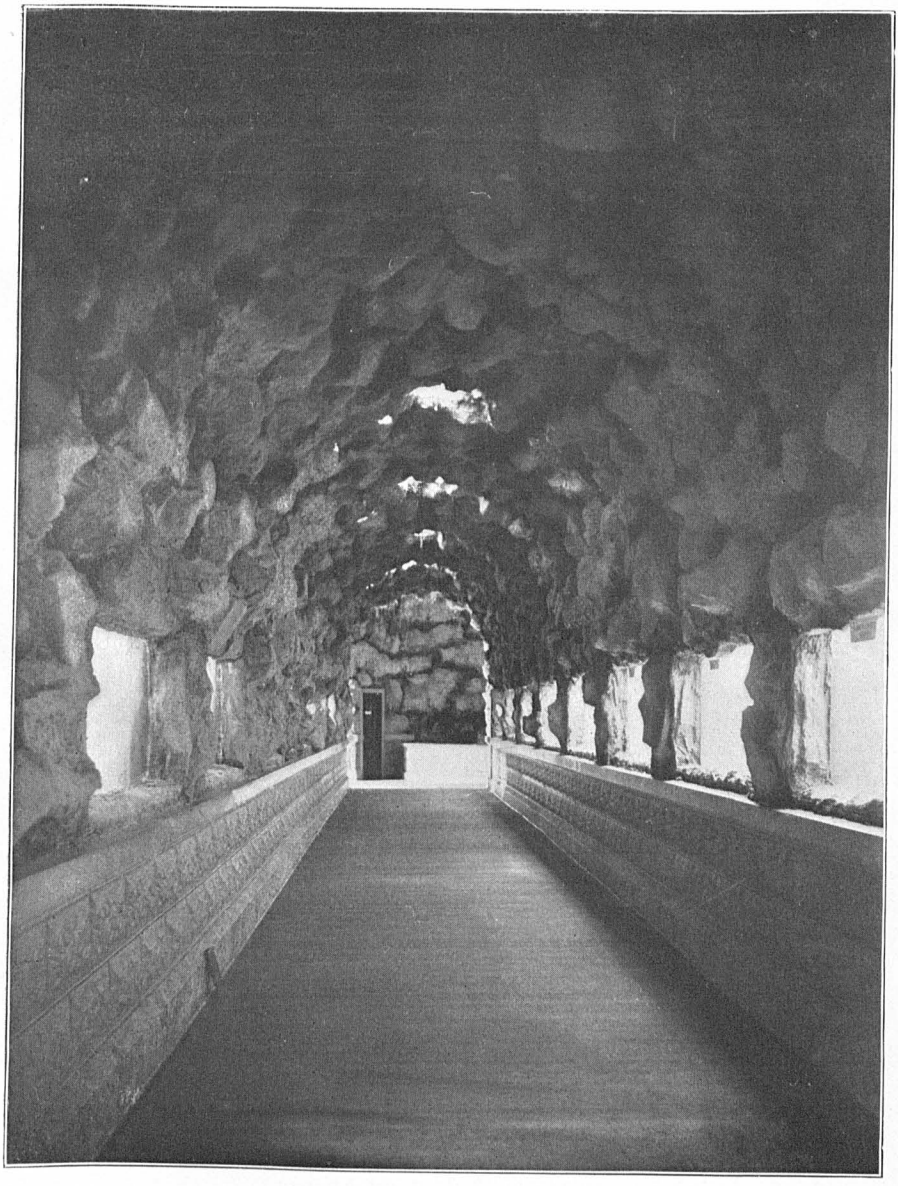
GREEN LAKE STATION, MAINE (E. E. RACE, SUPERINTENDENT).

During the summer, various minor improvements and repairs to buildings and ponds were made by the station force, including the painting of the hatching and collecting apparatus; a nursery containing 40 troughs was built in the rear of the hatchery, arranged so that the surplus water can be utilized for the rearing-ponds. An orchard was set out between the superintendent's cottage and the hatchery. At the beginning of the fiscal year the stock on hand was as follows:

Species.	Calendar year in which fish were hatched.		
	1897.	1896.	1891.
Landlocked salmon	131,141	434	471
Brook trout	116,122	.....	.....
Golden trout	22,136	.....	.....
Steelhead trout	9,335	.....	.....
Atlantic salmon	16,220	.....	.....

Owing to an unprecedented rise in temperature early in July, it became necessary to dispose of the brook and golden trout, and they were planted in the tributaries of Green Lake. The balance of the fish were retained until early fall and distributed as usual to applicants in the New England States. No mortality from disease occurred during the season, but from July 7 to 15 the losses from heat were quite heavy, the temperature during that period reaching 81° in the troughs and 83° in the ponds.

In August arrangements were made for collecting eggs of the landlocked salmon, brook trout, and golden trout at Winkempaugh Brook (Branch Pond), Patton Pond, Flood Pond, Green Lake, and its tributaries. Steps were also taken to collect eggs of the lake trout (togue) and landlocked salmon in Cold Stream Pond, near Enfield. The traps



INTERIOR OF THE GROTTO, LOOKING FROM ONE THE POOLS, OMAHA.

and pens were put in place during August and September, and the first trout were captured in the latter month. At Cold Stream Pond the lake trout made their appearance on the spawning-grounds October 8, and the run continued until the 19th.

The following table shows the number of fish captured at the various field stations and eggs secured:

Point of collection.	Species.	Fish.	Eggs.
Winkempaugh Brook	Brook trout	206	207,000
	Landlocked salmon	59	182,000
Patton Pond	Brook trout	70	105,000
	Landlocked salmon	3	3,500
Flood Pond	Brook trout	59	28,000
	Landlocked salmon	2	
	Golden trout	146	83,500
Green Lake	Brook trout	21	18,200
	Landlocked salmon	127	273,000
Cold Stream Pond	Lake trout (togue)	75	150,000
	Landlocked salmon	44	100,000

The number of eggs secured exceeded the collections of past seasons, 558,500 landlocked salmon eggs being obtained from 235 adults, an average of over 2,000 per fish. At the close of the spawning season the fish were all liberated, without loss, in the waters from which they were taken. The results attained at Enfield were particularly gratifying, considering that operations were undertaken at that point late in the season. It is expected that over 1,000,000 togue eggs will be collected there another season, as the fish are abundant and easily captured. Of the 150,000 eggs secured, 75,000 were left at Enfield in charge of Mr. E. J. Darling, superintendent of the State hatchery, to be hatched and liberated in the waters from which they were derived. The brook-trout and landlocked-salmon eggs collected at Flood Pond, Winkempaugh Brook, and Patton Pond were hauled to the station by wagon over rough country roads immediately after fertilization and suffered a loss during incubation of from 8 to 14 per cent, whereas the loss on the eggs collected from fish captured in Green Lake and penned at Great Brook (about ¼ mile from the hatchery) was only 3½ per cent.

During the late fall and early winter 126,243 landlocked-salmon eggs, 25,000 brook-trout eggs, and 10,000 golden-trout eggs were shipped to various State fish commissions, private applicants, and other stations of the Commission. The balance of the eggs were held at the station to be hatched and liberated as fry and yearlings. The fry commenced hatching on January 4 and by April 30 were all out. In view of the heavy mortality experienced during the previous July it was decided to abandon all efforts to carry the brook and golden trout during the summer; 225,000 of the former and 59,144 of the latter were distributed during May and June.

On December 24 a consignment of 1,000,000 salmon eggs was received from Battle Creek, Cal., in excellent condition, only 7,270 having died en route; 50,000 of these were turned over to the State of Maine and the balance were distributed, immediately after the absorption of the sac, in Union River and its tributaries during the month of May.

Of the 50,000 steelhead-trout eggs received from Fort Gaston, Cal., in March, 22,966 fry were planted in Green Lake and other waters in the vicinity during the spring.

All the Atlantic salmon on hand at the beginning of the year were held until March 30, when they were liberated in Green Lake, with a loss of only 12. With the exception of 50 specimens, all of the domesticated salmon hatched in 1891 were planted in Green Lake during the fall, as the ponds occupied by them were needed for other fishes. A few thousand eggs were collected from the 50 referred to, but they died in less than forty-eight hours after being placed in the troughs. At the close of the year there remained on hand the following:

Species.	Calendar year in which hatched.	
	1897.	1896.
Landlocked salmon	336,936	279
Brook trout	13,831	.....
Steelhead trout	8,830	3,370

CRAIG BROOK STATION, MAINE (CHARLES G. ATKINS, SUPERINTENDENT).

The stock on hand July 1, 1897, consisted of 471,294 fish hatched the previous winter, chiefly Atlantic and quinnat salmon, a few landlocked salmon, steelhead, and Scotch sea trout; also 2,464 adults, varying in age from 2 to 6 years. All of the fry hatched the previous spring were held during the sac and early feeding stages in the standard troughs used at the station. They were supplied with water obtained from Craig Brook, its temperature during June ranging from 50° to 67°. Press of other work delayed the transfer of these fish to the ponds until after the middle of July, and the last of them were not removed until a month later. It was feared that this delay acted unfavorably on their growth, as the troughs were somewhat crowded. There were no serious losses from disease, however, as none of the epidemics occurring in past years made their appearance. The mortality in July amounted to 14,000, in August less than 5,000, and in September 2,300. To reduce the stock, 100,143 of the quinnat salmon were liberated early in September, and in October and November they were all disposed of except 5,883, which were retained throughout the winter.

The growth of the fish during the summer, though satisfactory, was not equal to that attained in former years, when maggots formed an important part of the food supply. These were not available this year, as the building erected for their production had to be transformed into a hatchery to meet the unusual demands made upon the station by the hatching of quinnat salmon the previous winter. The food material was therefore limited to the carcasses of horses and other condemned animals, beef liver, and butchers' offal.

The distribution of the fish was made by teams to local waters and by messengers to points at a distance from the station. As soon as it was completed the hatchery was filled with eggs collected from the Atlantic salmon confined in Dead Brook. The 350 female fish produced

3,506,642 eggs, which were much larger than those of the previous year, and apparently of fine quality. Notwithstanding their good condition, the actual losses from lack of impregnation and other causes, up to the time when the division was made with the State of Maine, amounted to 304,642. The United States received 2,630,214 as its share, 500,000 of which were assigned to State fish commissions and private applicants, and 2,126,975 fry, or 99.86 per cent of those divided, were hatched in March and April. Besides these, the State of Maine turned back to the Commission 540,199 fry.

Plants aggregating 1,975,000 were made in May, as follows:

Locality.	Number.
St. Croix River at Vanceboro	137,500
Penobscot River and tributaries above Oldtown	1,482,500
Penobscot tributaries near Craig Brook	355,070

The balance of the stock was retained for rearing, and at the end of June numbered 636,817.

In May, 1898, the usual arrangements were made for collecting and impounding adult salmon for the next year's brood stock; 472 fish were obtained and impounded at Dead Brook, 400 of which belonged to the United States Fish Commission.

The domesticated Atlantic salmon on hand at the beginning of the year consisted of three lots, the first of which were hatched in 1892, the second in 1893, and the third in 1897. Of the third brood 1,029 were liberated in November, 1897, reducing that lot to 454. In November 25,287 eggs were secured from the first two lots, but they were defective in quality and none of them survived to the hatching period.

As arrangements had been made to carry on landlocked-salmon work at Grand Lake Stream, no efforts were made to collect at Toddy Pond, as heretofore. In March the surplus eggs from Grand Lake Stream, amounting to 62,462, were transferred to Craig Brook, and of the fry hatched from them 54,476 remain on hand at the close of the year.

All of the rainbow trout at the station were liberated in Alamoosook Lake in August, 1897, and nothing was seen of them till the following March, when several were observed spawning in Craig Brook just below the hatchery. Measures were taken to secure eggs, and by the end of April 54,408 had been collected from 199 adult trout. The fish were undoubtedly a part of those liberated in August, and were apparently in excellent condition. The eggs were not first-class in quality, however, and only 35,000 fry were hatched. At the close of the year 28,351 remain, which appear to be doing well.

In order to test the practicability of domesticating the steelhead trout, the 191 specimens on hand from the hatch of 1896 were placed in one of the large deep ponds recently constructed and held for future service as breeders. The fish on hand from the hatching of 1897 were liberated during the fall, except 1,400, which were retained in a small pond until March, when it was found that only 180 of them remained.

This loss was first attributed to mink, but it appeared later that they were destroyed by eels. In April a consignment of 100,000 eggs was received from Fort Gaston, Cal., arriving in excellent condition. They yielded 95,904 fry, 35,941 of which were released in local waters in June. The remainder were held for rearing.

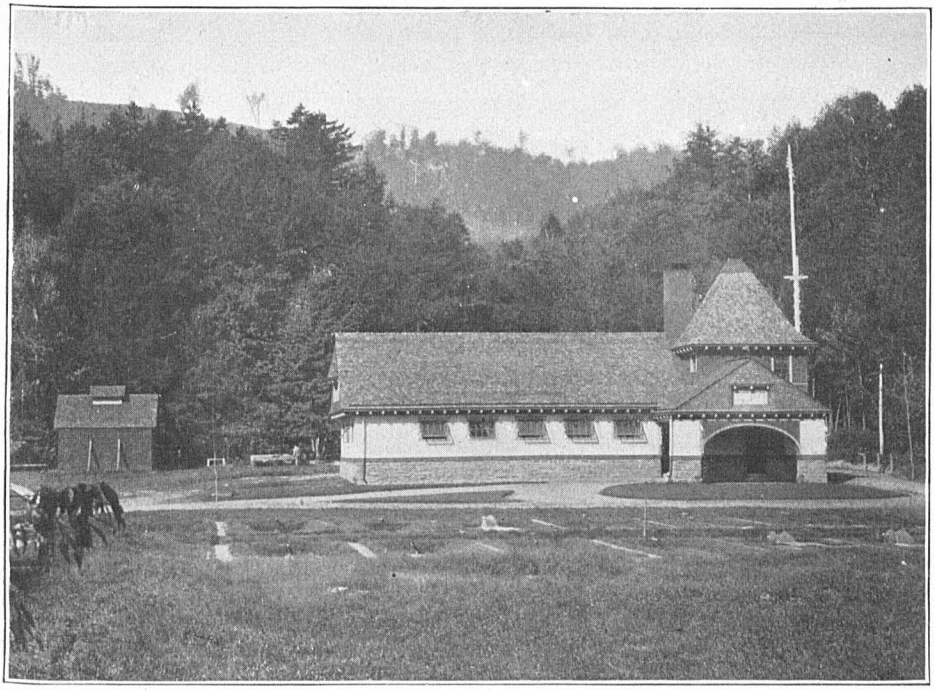
Of the Scotch sea trout resulting from eggs presented to the Commission by the journal *Shooting and Fishing* in 1891, there remains on hand a lot of 10; also two lots derived from eggs produced by these fish. All of the third lot were distributed during the year, and a crop of eggs is expected this fall from the second lot (hatched in 1895). In November, 1897, the 10 referred to above yielded 10,034 eggs, from which 2,970 young were hatched. The majority of the eggs proved defective and the fish hatched have continued to die, so that at the close of the year only 1,198 remain.

The stock on hand at the station on June 30, 1898, is as follows:

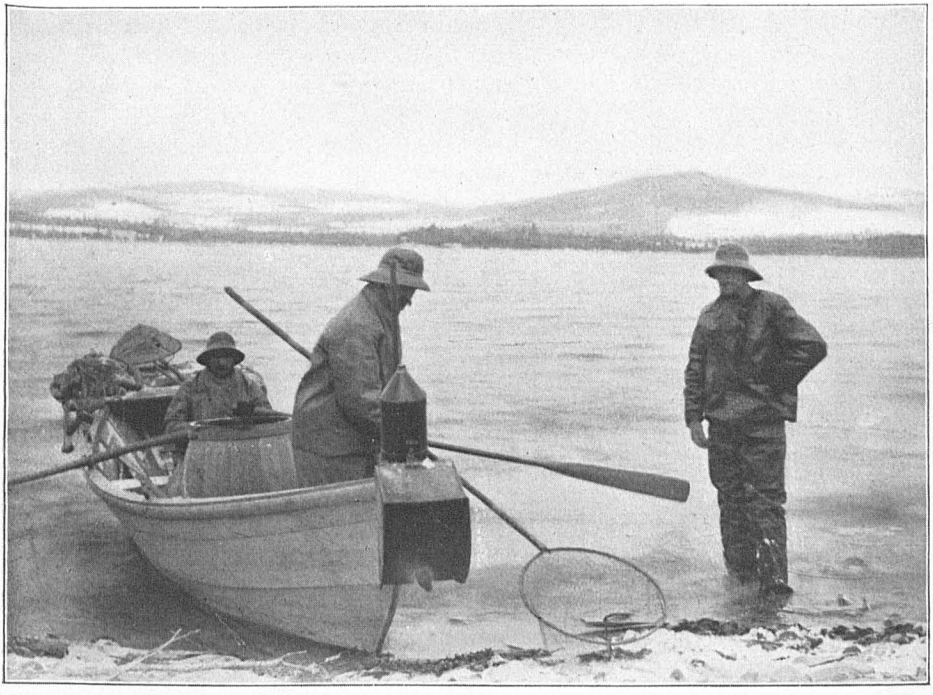
Kind.	Fish hatched in calendar year—					
	1898.	1897.	1896.	1895.	1894 or earlier.	Adult, wild-bred.
Atlantic salmon	636,264	.....	.....	.....	233	400
Atlantic salmon, domesticated	.....	454	.....	.....	35	.....
Landlocked salmon	54,476	.....	.....	.....	1	.....
Quinnat salmon	.....	28	.....	.....	.....	.....
Brook trout	2,666	.....	.....	.....	.....	.....
Rainbow trout	28,351	.....	.....	.....	.....	.....
Steelhead trout	38,745	.....	188	.....	.....	.....
Scotch sea trout	1,198	.....	.....	508	10	.....
Total	761,700	482	188	508	279	400

GRAND LAKE STREAM.

Work was resumed at Grand Lake Stream in the fall of 1897, after a lapse of five years, arrangements having been made with the International Leather Company, of Boston, who controlled the tannery property, for the necessary land and water rights and the occupancy of the buildings. The work was directed by Mr. W. O. Buck, one of the employees of Craig Brook Station, under the supervision of the superintendent. A few needed repairs were made to the buildings in September and October, and the water supply to the hatchery was increased by the renewal of the aqueduct. Barrier nets, to prevent the salmon running downstream, were put in place about the middle of September, and pounds for their capture were set as heretofore. The fishing had been excellent the two preceding springs, and as it was now time that these waters should show the good effects of the last two years' work of the Commission (1892 and 1893), when several hundred thousand yearlings were liberated, a good season's work was expected. The catch proved small, however, the total being only 337, of which 129 were males. The longest fish captured measured 24 inches and the heaviest weighed 5 pounds. The average length and weight were 20.2 inches and 3.21 pounds for the males, and 19.7 inches and 3.36 pounds for the females. The total number of eggs taken was estimated at



1. HATCHERY AT ST. JOHNSBURY, VERMONT.



2. BOAT EQUIPPED WITH JACK LIGHTS FOR CAPTURING TROUT AT NIGHT ON THEIR SPAWNING-BEDS AT CASPIAN LAKE.

313,800, but after the unfertilized ones had been picked off there remained only 245,150. Of these, 60,000 were shipped as follows:

Consignment.	Number.	Consignment.	Number.
Connecticut Fish Commission	10,000	D. Vinciguerra, Rome, Italy	5,000
Michigan Fish Commission	10,000	Wisconsin Fish Commission	10,000
New Hampshire Fish Commission	10,000	H. W. Poor, Wilson Mills, Me	15,000

Nearly half of the remainder were transferred to Craig Brook, and the balance were held at the station to be reared and liberated in Grand Lake Stream the coming fall. At the close of the year the fish seemed to be in excellent condition. Their food consisted of beef livers, obtained once or twice a week from Calais.

ST. JOHNSBURY STATION, VERMONT (J. W. TITCOMB, SUPERINTENDENT).

On July 1 the stock of fish on hand was as follows:

Species.	Calendar year in which hatched.		
	1897.	1896.	1895.
Landlocked salmon	4,579	.....	.....
Quinnat salmon	81,944	.....	.....
Steelhead trout	16,379	.....	36
Rainbow trout	.....	437	.....

All of the Pacific salmon which had been held in the nursery ponds supplied by water from Sleeper River, except 1,000 retained for experimental purposes, were distributed early in July on account of the sudden rise in the temperature, which reached 82° on July 5 at 6.30 p. m., causing the loss of 14,500 of the fry. Of the fish retained, 776 were alive at the close of the fiscal year. The landlocked salmon fry were held until the end of July, when they were planted in Lakes Morey and Caspian, and the steelhead trout were planted about the same time in Lakes Morey, Willoughby, and Champlain.

During the summer preparations were made for securing a supply of brook-trout eggs from wild trout by the establishment of auxiliary field stations. The stations operated the previous year at Darling Pond, Groton, and at Caspian Lake, Greensboro, were put in order, and the superintendent visited Willoughby Lake at Westmore, Ewel's Pond at Peacham, Garfield Pond at Danby, Silsby's Pond at Newbury, and a number of others, with a view to operating experimental stations at those points. As a result of his investigations, operations were undertaken at Lakes Willoughby and Ansil, and at the ponds of the Wells River Fish and Game Club. The only results secured from these were 14,525 lake-trout eggs at Willoughby Lake; and as the expense involved in the collection of these was great, the work was abandoned.

Work at Caspian Lake was begun on October 11, and continued until the 27th, when operations were discontinued, as only 66,022 brook and lake trout eggs had been secured. The failure at this point was appar-

ently either because the fish did not ascend to the usual spawning-grounds, or spawned in the deeper water under the ice. It is believed that a large number of lake-trout eggs may be collected at this point in the future by the use of fyke nets. This station is well equipped for eyeing 800,000 trout eggs, and is regarded as one of the best fields in the State for collecting brook and lake-trout eggs.

At Darling Pond, Groton, the trap was put in on July 20, and kept in place until November 6. The temporary hatchery was opened on September 1 and closed on December 31, during which time 682,248 trout eggs were collected, 83 per cent of which were transferred to St. Johnsbury when they had reached the eyed stage. The results at this station were very satisfactory, for although in the previous season 961,318 eggs were collected, only 23 per cent were saved—the loss being apparently due to the improper handling of the eggs. During the season, 5,000 trout were handled; of these, 1,734 were ripe females. The temporary hatchery is an abandoned farmhouse, supplied with about 45 gallons of spring water per minute, and can be operated economically. The experience at Darling Pond would indicate that the eggs taken from fresh-run fish are much stronger and yield a better percentage of fry than those taken from fish that have been confined for several weeks before they are ripe, as is necessary here.

At Fairbanks Pond 78,547 eggs were collected by the employees of the station, of which 70 per cent were hatched. Of the total number collected 120,300 were shipped to applicants in Eastern States and in Europe. The balance and an additional 200,000 purchased were held at the station to be hatched and distributed during the spring.

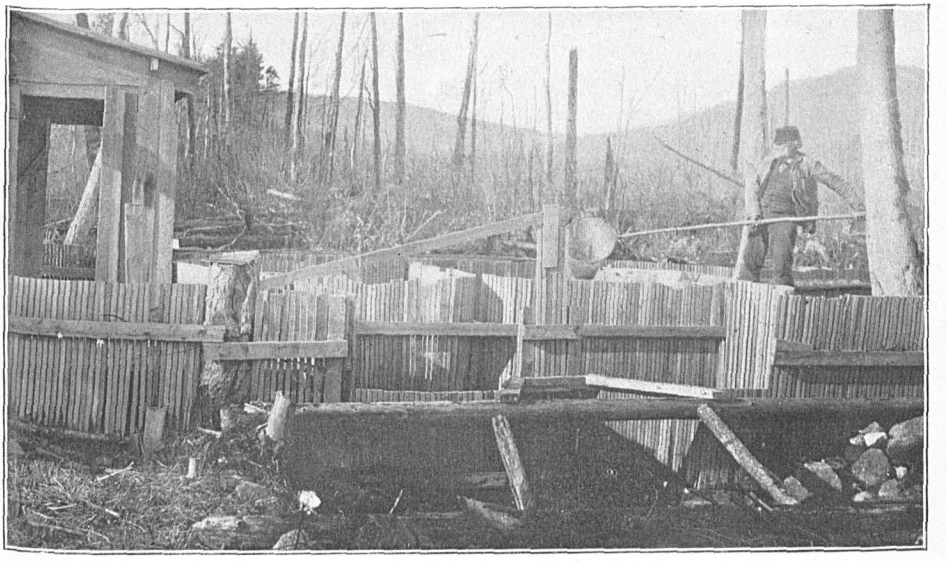
The brook-trout eggs hatched during February and March, with comparatively small loss, over 716,000 fry being produced; 561,000 of these were planted in April, May, and June. The lake-trout eggs produced 14,000 fry, which in the spring were planted in Lake Dunmore and in ponds at Derby.

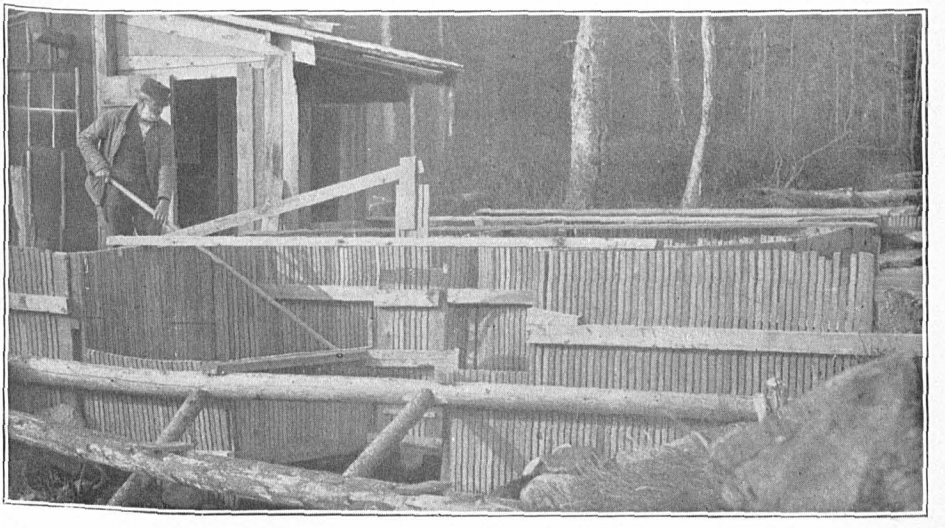
At the request of H. F. Hurlbut, of East Freetown, Mass., and of Charles A. Hoxsie, of Carolina, R. I., 70,000 eggs collected from wild trout were exchanged for the same number produced at their hatcheries.

On February 23, 10,000 landlocked-salmon eggs were received from Green Lake Station, only 50 dead ones being picked out on their arrival. Of this shipment 9,900 hatched, and at the close of the year 9,138 fry were on hand, which are held for distribution in Vermont waters. Of 100,000 steelhead-trout eggs received from Fort Gaston on March 23, 91,000 fry were planted during May and June.

At the close of the year the stock on hand was as follows:

Species.	Calendar year in which hatched.			
	1898.	1897.	1896.	1895.
Steelhead trout	3,963	.....	.....	35
Rainbow trout	.....	.....	410	.....
Pacific salmon	.....	776	.....	.....
Brook trout	6,199	.....	.....	.....
Landlocked salmon	9,138	.....	.....	.....





TWO VIEWS OF TRAP AT GROTON, VERMONT, 1897.

The Pacific salmon fry placed in the ponds for experimental purposes weighed 1 pound 10 ounces to the thousand on July 1. These were confined in a pond about 8,000 square feet in area. In January, 1898, they weighed 41 to the pound, and in June the average weight had increased to 12 to the pound. Great dissimilarity was noticed in the color and shape of lake-trout eggs taken from different waters. For example, the eggs of the lake trout taken at Willoughby Lake closely resemble those of the landlocked salmon, and are much larger than those from Caspian Lake, 600 of the Willoughby Lake eggs equaling 4 fluid ounces, while it required 800 from Caspian Lake to fill the same measure. It was also noticed that the fry hatched from the Caspian Lake eggs were much smaller and more active.

During April, as the troughs in the hatchery were much crowded, some of the fry were transferred from them to the nursery ponds, 10,000 to each pond. These ponds had not been used for six months, and were supplied with water from Sleeper River. The fry in the ponds had the same care as in the hatchery, except that it was impossible to clean them as thoroughly. No unusual mortality was observed, and at a careful examination of the outlets, to see if the fry were escaping, everything appeared to be perfectly tight; but on June 6, when these fish were taken from the ponds for shipment, only 25 per cent of the number originally placed there were found. It is difficult to account for the disappearance of the balance, though it was possibly due to cannibalism, as the fish taken from the ponds were at least three times as large as those of the same age taken from the troughs. This larger growth may to some extent be due, however, to higher temperature of the water, and to the presence of some natural food. It was observed that under the same conditions—i. e., with the same number of brook trout, steelhead trout, and landlocked salmon, in ponds of equal size—the landlocked salmon stand a much higher temperature than any of the others.

The food used at the station has consisted principally of livers, with the addition of insect larvæ obtained from the refuse of livers, crows, woodchucks, etc. One woodchuck produced 1 quart of maggots.

Enemies of the fish have been the source of but little trouble during the past year, except in the case of the kingfisher, many of which have been killed. In October a colony of muskrats made their headquarters in one of the ponds, and before they had been discovered had made 12 holes in the banks, one of which caused a leak. These animals were shot and trapped. All were males, indicating that the males precede the females in the preparation of the winter homes. Mink were seen occasionally along the river, but no trouble was experienced from them.

Several landlocked salmon from the plants made by the Commission were caught with hook and line at Lake Morey, Fairlee, Vt., in May, 1897, and it is expected that in a few years this lake will afford a valuable field for the collection of this species. In May, 1898, a landlocked salmon weighing 4¾ pounds was taken at Caspian Lake. In Sleeper River, which is the source of the water supply for the St. Johnsbury Station, rainbow and brook trout, quinnat salmon, Atlantic salmon,

and steelhead trout have been taken during the year. The plants were made in the headwaters of the river, but the fish worked down to the lower and deeper pools. The steelheads and Pacific salmon captured in Sleeper River averaged about 6 inches in length, while the rainbow trout ran from 6 to 12 inches; Atlantic salmon ranged from 5 to 7 inches. All of these fish were taken with angleworms, though the Pacific salmon will rise quite readily to the fly. The capture of steelhead trout and landlocked salmon is also reported from tributaries of Lake Champlain, but in some instances the varieties have not been thoroughly identified.

During the year the north embankment of the reservoir was rebuilt, and a tiled drain (144 feet in length) was laid below its base. The reservoir roof was covered with a preparation of tar and gravel, and the filter in the reservoir was renewed. The interior of the reservoir, containing about a foot of mud, was cleaned out, the sides washed down, and the entire interior given a whitewash coat of cement. A pipe was connected with the supply standpipe in the reservoir filter, and run through the filter crib into the reservoir, giving the latter a direct supply of water from the river in case of emergency. A ventilator was placed in the reservoir roof to ventilate the reservoir and prevent heating under the roof, and the consequent decay of timbers. Seven new ponds were constructed—Pond H and six small rearing-ponds. The spring-water supply to the hatchery was connected directly with the distributing crib, for use in the ponds when the hatching-troughs were not in use. The arrangement of the hatching and picking troughs was changed so as to place the latter under the windows on the east side of the hatchery, and supply all the troughs with the water from the west side, instead of from both sides, as formerly. This change gives more floor space, connects all troughs with the spring-water supply, and reduces the amount of water required in the hatchery. Its successful operation during the season indicates a great improvement.

On September 27 ground was broken for the construction of a residence for the superintendent. The work was continued throughout the winter and the house completed on June 30, except the interior finishing. The residence consists of ten rooms and is a two-story frame house, with stone and brick foundation, heated by furnace and supplied with modern plumbing.

Under authority of act of Congress, authorizing an expenditure of $3,000 for an increased supply of water at the station, a contract was entered into with Carpenter & Williams on April 20, 1897, for an artesian well. Work was commenced on April 21, and at the close of the fiscal year a well 200 feet deep had been sunk.

CAPE VINCENT STATION, NEW YORK (LIVINGSTON STONE, SUPERINTENDENT).

The hatching apparatus was thoroughly overhauled during the summer and the first floor of the hatchery fitted up with Williamson troughs, preparatory to hatching quinnat-salmon eggs, which were to be transferred from the Pacific coast. The old method of securing water by means of pumps was abandoned this year and arrangements

were made for obtaining the amount needed from the city waterworks company; this change has not only reduced expenses, but the quality of the water is better and the supply more reliable.

During October 133,140 lake-trout eggs were purchased from the fishermen operating on Charity Shoals at a rate of 15 cents per 1,000, and the 114,481 fry resulting from them were planted in Watson Bay. An assignment of 1,000,000 eggs of this species was also received from Northville, and the fry hatched, amounting to 967,850, were deposited in Lake Ontario and the St. Lawrence River.

In December 5,000,000 eggs of the quinnat salmon were received from Battle Creek, Cal. The fry hatched were carried through the winter without material loss, and with the exception of one plant of 328,000 in the Salmon River, they were all distributed in Lake Ontario and the St. Lawrence River within a radius of 25 miles from the station.

Consignments of 100,000 each of brook trout, steelhead trout, and Atlantic salmon eggs were received during the year from other stations, and were hatched and distributed as usual; 10,000 steelhead eggs were repacked and shipped to Osnabruck, Germany, where they arrived with the loss of only 420, after a journey of nearly 8,000 miles.

Early in the spring the superintendent made an investigation of various fishing-grounds on Lake Ontario to arrange for the collection of pike-perch eggs, as there was a general desire on the part of the fishermen on the lake that the propagation of this species be undertaken. The investigation showed that there are no localities in the vicinity where eggs can be obtained in large quantities, though the spawning fish formerly occurred in great abundance throughout this region. The fishermen stated that where tons of fish had been captured two years ago, there was now practically no fishing. The disappearance of fish from their usual spawning-grounds was attributed by some persons to the discharge of refuse from mills and factories into the tributaries of Lake Ontario. In April 30,000,000 eggs of the pike perch were transferred from Put-in Bay, and the majority of the fry resulting from them were planted without loss in the St. Lawrence River; one plant of 800,000 being made in the Oswegatchee River. It is reported that pike perch are abundant in some of the inland lakes of the State, and a collecting station, similar to the one operated by the New York Fish Commission on Lake Oneida at Constantia, may be established in the future.

The following shows the number of eggs handled and fry hatched at the station during the fiscal year:

Species.	No. of eggs received.	Fry hatched.
Lake trout	1,133,140	982,331
Quinnat salmon	5,000,000	4,690,801
Brook trout	100,000	56,000
Atlantic salmon	100,000	97,071
Steelhead trout	100,000	90,000
Pike perch	30,000,000	10,043,750
Total	36,433,140	15,960,013

An investigation was made by the superintendent with the view to undertaking the propagation of sturgeon, but no point could be found at which a sufficiently large number of spawning sturgeon are caught to warrant the establishment of a field station, although sturgeon nets are fished all the way from Ogdensburg to the eastern end of Lake Ontario.

GLOUCESTER STATION, MASSACHUSETTS (C. G. CORLISS, SUPERINTENDENT).

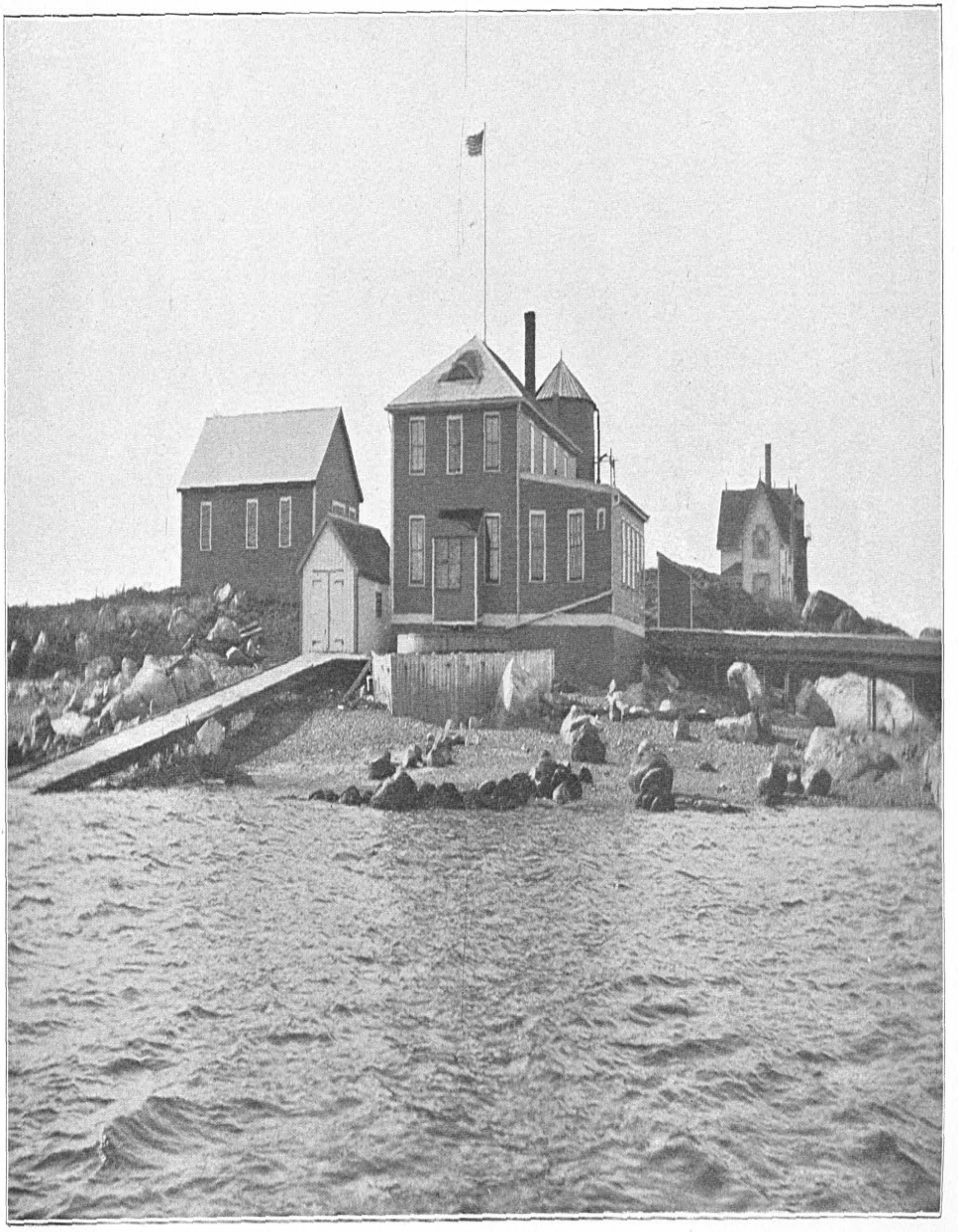
As soon as practicable after the 1st of July preparations were made for increasing the size of the hatchery and of the pumping plant. A one-story addition, 18 by 32 feet, was built on the northwest side of the hatchery and equipped with 6 new tables, containing 72 hatching-boxes, thereby doubling the capacity of the hatchery for cod work. A 40-horsepower boiler was installed in place of the small one which had been used for a number of years.

Immediately upon the completion of this work a force of spawn-takers was employed, and efforts were made to collect pollock eggs from the fisherman at Gloucester. As a result 7,791,000 eggs were collected during November and December, which produced 4,455,000 fry. The failure to secure the much larger results, which had been anticipated, was due to the method of fishing, all of the pollock being captured with hand lines instead of with gill nets, which had been formerly used. It is claimed that ripe spawning fish seldom take the hook.

On November 15 the crew of the *Grampus*, under the direction of Capt. E. E. Hahn, was stationed at Kittery Point for the purpose of collecting cod eggs. The methods pursued were practically the same as in past years. The eggs were collected by spawn-takers from fish captured by vessels having headquarters near Kittery. Arrangements were also made for purchasing eggs at $5 per 1,000,000 from fishermen not accompanied by spawn-takers. On the first of March collections were discontinued at Kittery, as the *Grampus* force was needed for the work on the vessel, and the last of the fry were hatched on March 26. A few eggs were purchased after that date. The total collection of the season amounted to 160,711,000, the first being secured on November 17. The 96,707,000 fry produced were distributed along the Massachusetts coast from Ipswich Bay to Massachusetts Bay, off Baker Island, from 1 to 10 miles from the shore, on the natural spawning-grounds.

Record of cod-hatching at Gloucester Station, season of 1897–98.

When received.	Source of supply.	Eggs received.	Loss during incubation.	Fry hatched.	Date of hatching.	Date of planting.
1897.					1897.	1897.
Nov. 17	Kittery Point	2,480,000	761,000	1,719,000	Nov. 29	Nov. 30
18	.....do	1,272,000	516,000	756,000	30	30
19	.....do	2,238,000	478,000	1,760,000	Dec. 1	Dec. 1
20	.....do	515,000	176,000	339,000	3	3
22	.....do	2,921,000	599,000	2,322,000	5	5
23	.....do	2,785,000	692,000	2,093,000	6	7
24	.....do	1,470,000	416,000	1,054,000	7	7
25	.....do	482,000	71,000	411,000	9	9
28	.....do	1,416,000	525,000	891,000	13	13
29	.....do	3,440,000	671,000	2,769,000	13	13
Dec. 1	.....do	3,950,000	1,084,000	2,866,000	15	15
2	.....do	166,000	18,000	148,000	16	16



HATCHERY AT GLOUCESTER, VIEW FROM GLOUCESTER HARBOR.

Report U. S. F. C. 1898. (To face page L.)

Record of cod-hatching at Gloucester Station, season of 1897–98—Continued.

When received	Source of supply.	Eggs received.	Loss during incubation.	Fry hatched.	Date of hatching.	Date of planting.
1897.					1897.	1897.
Dec. 3	Kittery Point	2,896,000	958,000	1,938,000	Dec. 17	Dec. 17
4	....do	1,021,000	473,000	548,000	17	17
5	....do	1,398,000	562,000	836,000	17	17
6	....do	2,751,000	681,000	2,070,000	20	20
10	Kittery Point and Gloucester	2,264,000	775,000	1,489,000	26	26
11	....do	2,460,000	1,285,000	1,175,000	26	26
12	....do	1,924,000	610,000	1,314,000	27	27
13	....do	6,074,000	2,871,000	3,203,000	28	28
					1898	1898
14	....do	2,114,000	1,527,000	3,752,000	Jan. 2	Jan. 2
16	....do	11,894,000	7,594,000	4,275,000	4	4
17	....do	7,896,000	3,667,000	4,302,000	7	7
18	....do	1,205,000	697,000	508,000	4	4
20	....do	7,484,000	4,137,000	134,000	10	10
21	....do	1,069,000	781,000	288,000	10	10
22	Gloucester and Plymouth	2,817,000	1,951,000	866,000	10	10
23	Gloucester	164,000	32,000	132,000	10	10
26	....do	677,000	118,000	559,000	10	10
27	Kittery Point	3,176,000	925,000	2,251,000	12	12
28	....do	1,306,000	316,000	990,000	12	12
29	....do	1,503,000	623,000	880,000	14	14
30	....do	316,000	86,000	230,000	14	14
31	....do	2,601,000	1,093,000	1,508,000	17	17
1898.						
Jan. 2	....do	4,239,000	1,909,000	2,330,000	19	19
4	Kittery Point and Plymouth	5,124,000	2,156,000	2,968,000	19	19
5	Kittery Point	1,372,000	694,000	678,000	21	21
6	....do	768,000	257,000	511,000	21	21
8	....do	1,492,000	820,000	672,000	25	25
9	....do	871,000	363,000	508,000	25	25
10	Kittery Point and Rockport	1,883,000	899,000	984,000	25	25
11	Kittery Point	571,000	217,000	354,000	25	25
12	Rockport	1,717,000	1,064,000	653,000	27	27
13	Rockport and Kittery Point	2,370,000	504,000	1,866,000	27	27
14	Kittery Point	864,000	283,000	581,000	20	20
15	Rockport and Kittery Point	5,317,000	1,883,000	3,434,000	29	29
16	....do	3,881,000	1,367,000	2,514,000	Feb. 3	Feb. 3
17	....do	2,168,000	1,535,000	633,000	3	3
18	....do	7,474,000	2,182,000	5,292,000	4	4
19	....do	4,235,000	2,344,000	1,891,000	3	3
20	Kittery Point	74,000	31,000	43,000	7	7
21	Rockport and Kittery Point	1,468,000	652,000	816,000	7	7
22	Kittery Point	1,934,000	987,000	947,000	7	7
25	....do	1,489,000	402,000	1,087,000	11	11
27	Rockport and Kittery Point	3,868,000	986,000	2,882,000	13	14
28	....do	1,504,000	347,000	1,157,000	14	14
30	Kittery Point	1,920,000	1,062,000	858,000	18	18
Feb. 3	....do	166,000	74,000	92,000	20	23
5	....do	308,000	42,000	266,000	21	23
6	Rockport	400,000	86,000	314,000	22	23
7	Kittery Point	1,085,000	209,000	876,000	23	23
8	Kittery Point and Plymouth	2,030,000	472,000	1,558,000	23	23
9	Kittery Point	895,000	299,000	596,000	26	26
10	Rockport	1,862,000	589,000	1,273,000	26	26
11	Kittery Point	616,000	170,000	446,000	26	26
13	Kittery Point and Gloucester	1,472,000	253,000	1,219,000	28	28
14	Kittery Point	1,128,000	132,000	996,000	28	28
19	....do	532,000	91,000	441,000	Mar. 7	Mar. 7
26	....do	327,000	63,000	264,000	16	17
28	Gloucester	1,364,000	190,000	1,174,000	17	17
Mar. 6	Rockport	760,000	116,000	644,000	21	21
10	....do	1,600,000	221,000	1,379,000	24	24
14	....do	1,418,000	284,000	1,134,000	26	26
	Total	160,711,000	64,004,000	96,707,000		

The eggs transferred from Kittery to Gloucester were packed in tightly sealed jars and surrounded with crushed ice or snow, in charge of a messenger. As a rule they were of excellent quality, and were hatched as heretofore in the McDonald cod-box. As the water temperature fell it became necessary to use steam to maintain a temperature of between 38° and 40°, which has been found by experiment to be about the same as the temperature of the water on the natural spawning-grounds.

At the close of the cod season arrangements were made with the fishermen and dealers to save egg-lobsters at various points along the Massachusetts coast, and temporary collectors were employed and stationed at Boston and Kittery Point to look after the interests of the Commission in this work. The schooner *Grampus* was detailed to make collections along the Maine coast from Kittery to Rockland, and on account of the large extent of territory to be covered an additional steam smack was chartered to work in connection with the *Grampus*. As a result of operations on the coast of Maine, 22,023,000 lobster eggs were collected and delivered at the station. The first eggs were taken by the *Grampus* on April 11, and the collections were continued daily from that time until July 15. The lobsters purchased in Gloucester and vicinity, Kittery Point, Marblehead, and Boston were transferred to the station by means of a steam launch. This launch was also utilized in making the plants.

The collections made at the various points aggregated 6,445 lobsters, which yielded 72,101,000 eggs. The eggs were all hatched at Gloucester, and produced 65,097,000 fry, which were distributed along the New England coast from Rockland to Boston. Several of the shipments were taken to Maine waters by the *Grampus*, and a number of shipments were sent by rail in care of messengers to Portland, Maine, from which point they were distributed by the schooner. Heretofore considerable difficulty had been experienced in shipping lobster fry during warm weather on account of losses occasioned by sudden rises in temperature, as ice could not be used in the transportation cans, because it would reduce the density of the water. This year, by a simple device, the difficulty was overcome. A tin cylinder, attached to the cover of the regular transportation can and extending to within 6 inches of the bottom of the can, was kept constantly filled with crushed ice, and in this way the proper temperature of the water was maintained.

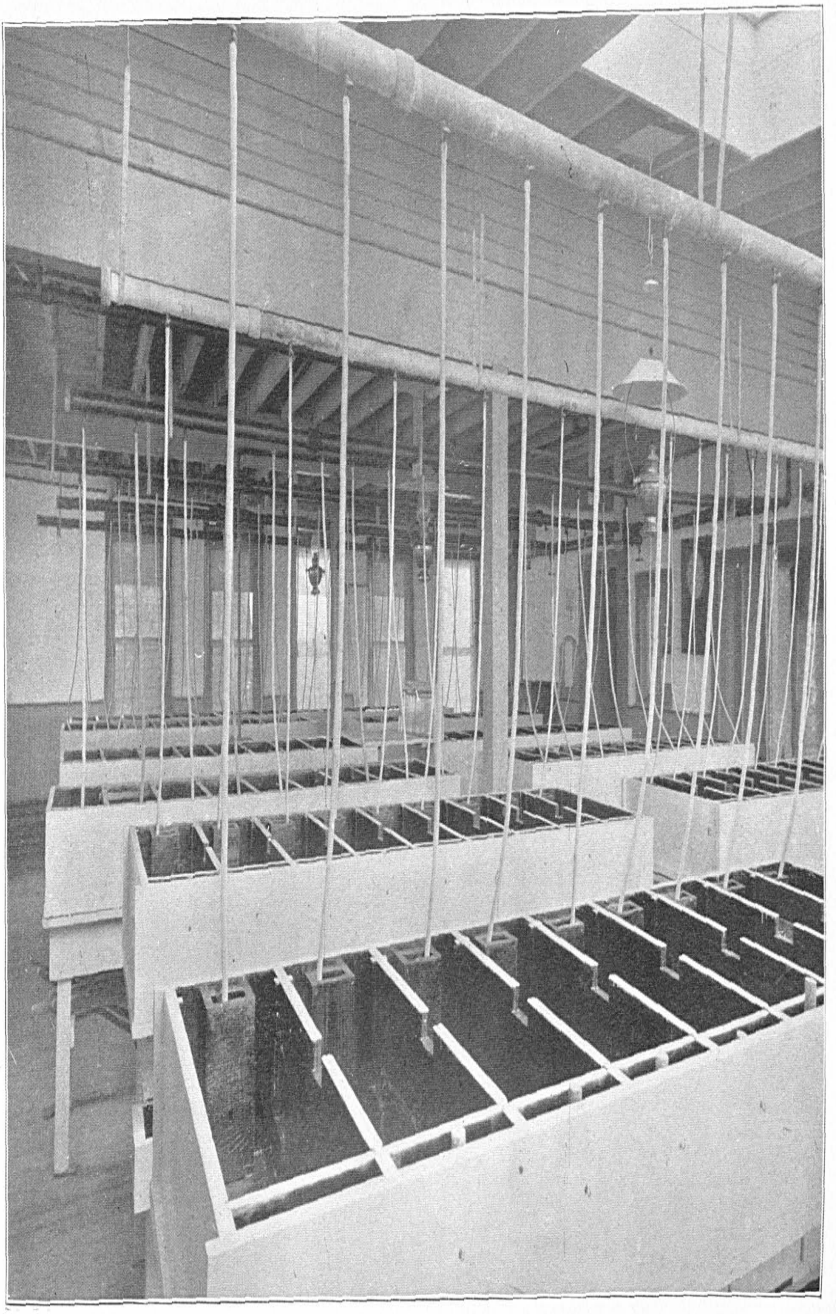
The following table shows the number of eggs collected from the various fields:

Locality.	Eggs collected.
Gloucester and vicinity	6,479,000
Marblehead	435,000
Kittery Point and vicinity	6,368,000
Maine coast, schooner *Grampus*	22,023,000
Boston and vicinity	36,796,000
Total	72,101,000

WOODS HOLE STATION, MASSACHUSETTS (E. F. LOCKE, SUPERINTENDENT).

During July and August various repairs were made to the residence and other buildings, including a new floor for the lower hall of the laboratory and repairs to the pool. The machine shop was removed from the loft over the fire-room to the lower floor of the carpenter shop.

The station force collected in July for shipment to the Pacific coast a carload of 2,017 small and 12 adult tautog, with 119 blue crabs.



INTERIOR VIEW OF GLOUCESTER HATCHERY, SHOWING COD BOXES IN OPERATION.

The bulk of these being lost en route, a second collection was made in November for shipment to the same point, which comprised 1,138 tautog and 150 lobsters. The force was also utilized during the spring in collecting a carload of live fishes, including forty-five species, for the Omaha Exposition, and two carloads of salt water were filtered and shipped to Omaha on May 1.

Arrangements were made for gathering information in regard to the movements, growth, spawning habits, etc., of the cod by attaching small tags to brood fish liberated at the close of the season.

The collection of brood codfish was made as usual by the schooner *Grampus* and by purchase from fishing-smacks. The first fish were received on October 8 and the last on November 9; in all 3,507 were secured. The minimum weight of the fish accepted was 6 pounds; 1,920 of them were caught by the *Grampus* and the remainder obtained from the fishermen. They were carefully transferred from the vessel to live-cars moored in the pool. The loss during October was normal, but about the middle of November the mortality became very heavy, and specimens of the dead fish were sent to Washington for examination. It was found that in a majority of cases the primary cause of death could be traced to hook wounds or other injuries received at the time of capture.

From the penned brood-fish 57,034,000 eggs were secured.

Arrangements were made for collecting cod eggs at Plymouth, Mass., by Capt. E. E. Hahn. A force of spawn-takers was stationed there in November under direction of F. S. Conley, the first officer of the *Grampus*, and the launch *Cygnet*, with a crew, was assigned for use in transferring the spawn-takers from the shore to the fishing vessels. About December 1 the force was increased to seven spawn-takers, the collection of eggs was commenced, and although the work was frequently interrupted by storms during winter, the season as a whole was favorable, resulting in the collection of 90,760,000 eggs.

The method of handling and packing eggs did not differ from that followed at Kittery. The eggs were usually sent by express, though in the case of large collections a messenger was sent with them to guard against accident. The majority of the eggs arrived at the station in excellent condition. The work was continued until February 26, at which time, as a result of the collections made at this point and from the fish penned at the station, 147,794,000 eggs had been collected. Several shipments were also received from Kittery Point, amounting in all to 5,642,000. These were sent by messenger as far as Boston, and then shipped in care of the baggage-master to Woods Hole. The total number of eggs handled at the station amounted to 153,436,000.

The eggs were hatched, as usual, in the McDonald cod box, steam being utilized to maintain an equable temperature of water when that in the hatchery fell below 40°. The fry were planted on the spawning-grounds off Gayhead, with the exception of 6,340,000, which were deposited near Provincetown, Mass.

Record of cod-hatching at Woods Hole Station, 1897–98.

Date.	Source of supply.	Eggs taken.	Loss during incubation.	Fry hatched.	Date of hatching.	Date of planting.
Nov. 15	Live-cars	474,000	147,000	269,000	Nov. 27	Nov. 30
16	do	805,000	108,000	550,000	28	30
17	do	237,000	26,000	148,000	28	30
20	do	947,000	131,000	679,000	Dec. 1	Dec. 3
22	do	380,000	42,000	275,000	2	3
26	do	2,227,000	442,000	1,280,000	8	9
30	do	3,649,000	693,000	2,218,000	13	14
Dec. 1	Plymouth	948,000	185,000	626,000	14	15
2	Live-cars	3,222,000	506,000	2,305,000	14	15
2	Plymouth	853,000	79,000	737,000	14	15
4	Live-cars	3,511,000	599,000	2,462,000	16	17
4	Plymouth	853,000	100,000	653,000	16	17
6	do	587,000	215,000	335,000	19	20
6	Live-cars	2,075,000	548,000	1,290,000	19	20
7	Plymouth	474,000	121,000	332,000	19	20
7	Live-cars	758,000	189,000	485,000	19	20
8	do	3,221,000	900,000	2,084,000	20	21
8	Plymouth	806,000	400,000	322,000	20	21
11	do	1,232,000	329,000	876,000	23	27
11	Live-cars	4,122,000	1,003,000	2,690,000	23	27
13	do	5,331,000	933,000	3,866,000	27	29
14	Plymouth	2,535,000	633,000	1,555,000	27	29
15	Live-cars	3,815,000	853,000	2,445,000	31	Jan. 3
16	Plymouth	568,000	100,000	304,000	31	3
16	Live-cars	1,422,000	404,000	724,000	Jan. 3	6
16	Plymouth	853,000	111,000	605,000	3	6
17	do	1,611,000	429,000	1,045,000	5	6
18	Live-cars	4,667,000	1,004,000	3,079,000	7	8
20	Plymouth	2,180,000	437,000	1,396,000	9	10
21	Live-cars	2,417,000	594,000	1,564,000	9	10
20	Plymouth	568,000	152,000	374,000	9	10
21	do	3,008,000	157,000	2,674,000	9	10
22	Kittery Point	1,611,000	515,000	969,000	12	15
22	Plymouth	1,250,000	210,000	945,000	12	15
23	Live-cars	2,123,000	447,000	1,497,000	13	15
23	Plymouth	1,090,000	79,000	970,000	13	15
23	Kittery Point	1,422,000	232,000	1,048,000	13	15
26	do	2,559,000	798,000	1,623,000	16	18
28	Live-cars	2,440,000	702,000	1,537,000	18	22
29	Plymouth	2,985,000	519,000	2,249,000	18	22
30	Live-cars	1,374,000	374,000	773,000	22	25
30	Plymouth	1,231,000	126,000	989,000	22	25
31	do	616,000	252,000	322,000	22	25
Jan. 2	do	4,264,000	1,037,000	3,055,000	22	25
3	Live-cars	616,000	155,000	398,000	24	25
5	do	663,000	136,000	485,000	27	31
6	Plymouth	1,137,000	236,000	816,000	27	31
7	Live-cars	996,000	242,000	658,000	27	31
8	Plymouth	711,000	90,000	593,000	27	31
9	do	2,130,000	253,000	1,767,000	31	Feb. 3
10	Live-cars	1,137,000	242,000	784,000	31	3
10	Plymouth	995,000	41,000	886,000	31	3
11	do	2,464,000	1,048,000	1,3[illegible],000	Feb. 4	7
12	Live-cars	900,000	253,000	573,000	4	7
12	Plymouth	592,000	105,000	419,000	4	7
14	Live-cars	663,000	169,000	447,000	7	8
15	Plymouth	2,037,000	221,000	1,722,000	7	8
16	do	1,943,000	189,000	1,013,000	7	8
17	Live-cars	758,000	205,000	511,000	12	14
18	Plymouth	2,178,000	632,000	1,314,000	12	14
19	do	7,250,000	1,893,000	4,989,000	12	14
19	Live-cars	711,000	200,000	511,000	12	14
20	Plymouth	1,659,000	99,000	1,519,000	15	18
21	Live-cars	332,000	42,000	280,000	15	18
21	Plymouth	1,659,000	105,000	1,492,000	15	18
22	do	758,000	42,000	701,000	15	18
24	Live-cars	711,000	237,000	442,000	19	22
25	Plymouth	5,543,000	1,032,000	4,087,000	19	22
27	Live-cars	190,000	105,000	69,000	19	22
Feb. 1	do	190,000	147,000	33,000	25	25
6	Plymouth	4,265,000	1,424,000	2,558,000	28	Mar. 2
7	do	1,564,000	197,000	1,332,000	Mar. 2	4
8	do	616,000	97,000	435,000	2	4
9	do	1,943,000	432,000	1,470,000	2	4
11	do	1,516,000	547,000	929,000	6	8
12	do	758,000	131,000	585,000	6	8
13	do	1,611,000	195,000	1,320,000	6	8
14	do	2,284,000	538,000	1,074,000	9	11
15	do	2,559,000	934,000	1,471,000	9	11
18	do	6,304,000	1,073,000	4,793,000	14	15
19	do	5,634,000	2,171,000	3,099,000	16	17
23	do	426,000	16,000	389,000	18	19
26	do	1,700,000	570,000	1,074,000	18	21
	Total	153,436,000	34,305,000	105,863,000		

The results secured with cod this year were far better than heretofore, and it is believed the work can be still further extended and increased by enlarging the force at Plymouth and using a larger steamer for transferring the spawn-takers to and from the fishing vessels.

Early in February steps were taken to collect the winter flounder or flatfish. For this purpose several fyke nets were set in Woods Hole harbor and Waquoit Bay, and the brood-fish taken were held at the station until ripe, when they were stripped and liberated. The first ripe fish were taken on February 11 in Woods Hole harbor, but owing to the presence of ice in Waquoit Bay the nets could not be set there until the 18th. The appearance of spent fish in the nets immediately after they had been set at the latter point indicated that the fish had commenced spawning much earlier, and that in order to do good work there it will be necessary to commence operations in January, weather permitting. Most of the fish taken were quite small, and the yield per fish was lighter than in past years. In 1897, 205 females produced 84,591,000 eggs, while this year 249 females yielded only 52,799,000, the average yield in 1897 being 456,000 per fish, and this year only 226,000. During the latter part of March efforts were made to secure eggs at East Greenwich, R. I. While only 4,804,000 were obtained here, it is thought that large numbers can be taken another season by stationing a man there to collect and forward the eggs early in February. Work closed on April 8, with a total take of 57,603,000, which produced 39,337,000 fry.

Following the custom of previous years, arrangements were made with local fishermen to take care of all egg-lobsters collected during the fall and winter, and between December 7 and January 19 about 500,000 eggs were secured. These were placed in jars, and developed fairly well until April 1. After that time the loss became very heavy and only about one-third of them hatched. Active operations commenced about April 1 and continued until June 30. The territory covered embraced all points fished within a radius of 15 miles from the station, and a schooner was employed to collect egg-lobsters at New London, Noank, and Stonington, Conn., and Block Island, R. I., while an agent was stationed at Plymouth, Mass., to collect from the fishermen located between Green River and Ship Pond, a distance of about 20 miles. Later in the season arrangements were made to collect eggs at Scituate, Mass., but only a few were received from that point. It is believed, however, that this section will yield a much larger number next year. Although the work was pushed energetically throughout the season, none of the territory covered yielded as many eggs as heretofore.

The following table shows the number received from the different localities in 1897 and 1898:

Localities.	1897.	1898.
Noank, Stonington, and Block Island	33,804,000	19,343,000
Woods Hole and vicinity, including Vineyard Sound and Buzzards Bay	35,013,000	11,620,000
Plymouth	5,335,000	4,428,000

The greatest difference will be noted as occurring in the vicinity of the station. This is attributed, first, to the well-known fact that the lobster fishery is steadily declining in this section; hence, the number of men engaged in the work becomes fewer each year, as the income derived from it is too small to support them. Another important factor is the legislation recently enacted prohibiting the fishing of pound nets in Buzzards Bay, which furnished the greater part of the bait used by the lobster fishermen operating in this territory. This caused a number of men to abandon the business. The same general decline has been felt in the waters south and west. It is reported that only about half the number of pots were set in the vicinity of Marblehead, Stonington, and Block Island, as compared with the previous year. The only direction in which operations could be extended would be on the north side of Cape Cod; but an additional steam launch would be necessary, which would materially increase the expense of the work.

The following table shows the species handled at the station during the fiscal year, eggs collected, and fry produced.

Species.	No. of eggs.	No. of fry.
Cod	153,436,000	105,863,000
Flatfish	57,603,000	39,337,000
Lobster	35,391,000	30,980,000
Total	246,430,000	176,180,000

EDISTO RIVER, STEAMER FISH HAWK (LIEUT. FRANKLIN SWIFT COMMANDING).

As a result of investigations made by the assistant in charge during December, the *Fish Hawk* was detailed to visit the Edisto River in March for the purpose of determining whether the fisheries are of such character and extent as to permit of fish-cultural work on a large scale. The vessel arrived at the mouth of the river on March 12 and proceeded upstream to a point a mile above the mouth of the Dawho, where good anchorage was obtained. That night 8 spawn-takers were sent out to examine the shad captured by the fishermen, and as a result 77,000 eggs were collected. These were placed in the jars and seemed to be in good condition until the 17th, when they commenced dying rapidly. As the temperature was favorable, averaging 66°, and the embryo was well formed, it was thought that the water was at fault, and it was tested for acids, but none were found. It is barely possible that the loss was due to the use of salt water in the pipes and machinery at Tampa; but this is not probable, as the pipes had been thoroughly rinsed with fresh water before the eggs were placed in the jars, and only a very slight trace of salt could be found when chemicals were used to test the water. The spawn-takers continued attending the nets, but no more eggs were obtained, though the fishermen reported that ripe fish had been caught for a week or ten days prior to the arrival of the vessel. The majority of those caught were hard and would have required at least a week to ripen, and, as the services of the vessel were needed on the Albemarle, work was discontinued on the 18th.

The present method of fishing on this river is such that fish-cultural work on a large scale is not practicable. Only one small seine is used; the balance of the fishermen use set gill nets, which are put out at low water and not overhauled till high-water slack. They remain in water until morning, when they are taken up and the fish removed, hence the only opportunity for spawn-takers to obtain the fish alive would be when they are first overhauled. The haul seine referred to is worked by 5 men and is fished only at low water during the day. Drift nets can not be used in this river on account of snags, shoals, and other natural obstacles. Gill-net fishing extends from a mile above the Savannah and Charleston Railroad crossing at Jacksonboro down to the Dawho River. This part of the river is known locally as the Pon Pon. There are 37 crews of 2 men each fishing in this region, each crew using two nets. They obtain an average of 1,000 fish per crew, though in the vicinity of the Oakhurst plantation, where the old State fish-hatchery is located, the catch is much larger, some crews taking from 1,800 to 3,000 per season. The State operated the hatchery referred to from 1880 to 1884, inclusive, and collected annually from 3,000,000 to 5,000,000 eggs. This hatchery is about centrally located as regards the fishing area, the contour of the river in that vicinity showing it to be especially adapted for spawning-grounds. If drift nets and haul seines were used, there would be little difficulty in collecting from 15,000,000 to 20,000,000 eggs each season.

During the stay of the vessel on the river the officers in command were indebted to S. Fitzsimons, Morton Simons, and T. D. Ravenel for assistance and courtesies extended.

ALBEMARLE SOUND, STEAMER FISH HAWK.

Owing to a delay of some days at Ocracoke Inlet on account of the extremely low tide, the vessel did not reach Avoca until March 28. Anchorage was made at the entrance to Salmon Creek on account of its proximity to the fishing-grounds and because of the partial shelter which it affords to the ship's boats. Spawn-takers were immediately sent to the fishing-grounds controlled by Dr. W. R. Capehart and Mr. T. D. Holly, and 147,000 eggs were secured from these sources on the first day. It was also intended to collect from the seines on the Roanoke and from those controlled by the Wood Brothers across the bay, but as very few fish were being taken at these points the attempt was abandoned. Eggs continued to come in daily from the arrival of the vessel until April 25, the total take aggregating 12,334,000. Of these, 10,242,000 were secured from Dr. Capehart's seines.

The results attained in this region would undoubtedly have been much better had the weather conditions been more favorable. It was exceedingly warm during March, and consequently the number of fish captured then was unusually large, the take at one fishery being four times as great as that of the preceding year for the same period. About the time the vessel arrived it became much cooler, and the mean temperature from March 30 to April 19 was under 60°. This tended not only to

keep the spawning fish out in deep water, but it greatly retarded the hatching of the eggs and caused the death of large numbers of fry. As an experiment, artificial heat was applied to the water in the supply tank with the view to maintaining an even temperature of 68° in the jars; but this plan was soon abandoned, as it would have been impracticable to hold the fry in artificially heated water until that in the sound reached the same temperature.

The distribution of the fry commenced on April 21, and at the close of operations 5,647,000 had been planted, also 1,811,000 eggs. The remaining 2,194,000 eggs were transferred to Central Station.

Shad-hatching operations on steamer Fish Hawk in Albemarle Sound in 1897–98.

Date.	Shad.	Eggs taken.	Mean temperature of water.	Date of hatching.	Number hatched.
Mar. 28	6	147,000	62	.....	.....
29	28	462,000	62	.....	.....
30	22	557,000	61	.....	.....
31	14	339,000	57	.....	.....
Apr. 1	8	182,000	55	.....	.....
2	28	569,000	56	.....	.....
5	4	77,000	54	.....	.....
6	6	129,000	53	.....	.....
7	8	123,000	54	Apr. 8	1,126,000
8	4	131,000	55	.....	.....
9	46	719,000	55	.....	.....
11	6	122,000	56	Apr. 11	382,000
12	20	398,000	57	.....	.....
13	36	772,000	59	Apr. 13	71,000
14	30	713,000	59	.....	.....
15	34	633,000	58	.....	.....
16	44	695,000	56	.....	.....
18	58	991,000	59	Apr. 18	115,000
19	30	644,000	58	Apr. 19	600,000
20	20	415,000	61	.....	.....
21	50	995,000	62	Apr. 21	150,000
22	12	546,000	61	Apr. 22	561,000
23	40	932,000	62	Apr. 23	189,000
				Apr. 24	713,000
25	44	1,043,000	65	Apr. 25	1,027,000
				Apr. 26	713,000
Total	398	12,334,000	.....	.....	5,647,000

On April 26, after the plants had all been made, the vessel proceeded through the Chesapeake and Albemarle Canal to Norfolk, en route for Delaware Bay, to resume the hatching of shad at that point.

DELAWARE RIVER, STEAMER FISH HAWK.

The vessel arrived at Gloucester, N. J., on May 3, and at once commenced the collection of eggs from the seines fished in Howell Cove, Riverton, and other points between Gloucester and Philadelphia, over 2,000,000 being secured the first night. Work continued uninterruptedly until May 11, when operations were cut short, as the Navy Department called for the services of the vessel in connection with the Cuban blockade. During this short period over 12,433,000 eggs were secured, but, owing to the unusually cold weather prevailing and the consequent low temperature of the water, many of them died in the jars. The 5,342,000 remaining when work was discontinued on the 11th were transferred to the Pennsylvania State hatchery at Bristol, Pa., together with the hatching apparatus and such boats and launches belonging

to the vessel as were needed for conducting operations at that point. The vessel was then taken to the League Island navy-yard, Philadelphia, and turned over to the Navy Department.

BRISTOL STATION, PENNSYLVANIA (G. H. TOLBERT IN CHARGE).

Anticipating the probable detail of the *Fish Hawk* to duty under the Navy Department, tentative arrangements had been made early in the spring with the State Fish Commission for the use of their hatchery on the Delaware River, and as soon as it was learned definitely that the vessel was to leave the service of the Commission, Mr. G. H. Tolbert, fish-culturist at large, was instructed to proceed to Bristol and prepare the hatchery for the reception of eggs. The hatchery is a two-story frame building, and is equipped with 120 McDonald jars and a good steam plant. Immediately upon the arrival of Mr. Tolbert the necessary employees were taken on and, with the assistance of the crew of the *Fish Hawk*, everything was in readiness for the commencement of work by May 13. A small force of spawn-takers was employed to attend the seines between Bristol and Riverton, and work proceeded uninterruptedly till the end of the month, 10,848,000 eggs being secured from the seines at Riverton, 1,841,000 from North Cramer Hill, and 220,000 from Dutch Neck and Badger Island. In addition to the 5,342,000 eggs turned over by the *Fish Hawk*, 3,095,000 were transferred from Battery Station, making a total of 21,346,000 handled at this point during the spring. These yielded 15,460,000 fry, which were liberated during May and June in the Delaware River and its tributaries. At the close of operations on June 10 the temporary employees were discharged, and the hatchery turned back to the State Fish Commission. The results would indicate that under more favorable conditions and by the employment of a larger force, from 30,000,000 to 40,000,000 eggs might be collected here during the spring.

BATTERY STATION, MARYLAND (ALEXANDER JONES IN CHARGE).

Anticipating an early run of shad on account of the mild weather in March, preparatory work commenced sooner than usual, and by April 10 the station was in readiness for active fish-cultural operations. The temporary force of 36 employees was taken on between that period and the middle of the month. To encourage the collection of eggs by the fishermen, two spawn-takers were stationed at Havre de Grace to receive and care for all taken in that vicinity, and four men were detailed on a schooner in Northeast River to obtain all that were available at that point. Spawn-takers were also stationed as usual at the seines fished at Carpenter Point and on Osmond's float below Havre de Grace. The remainder of the force worked the boats from the station and accompanied the launches on the nightly trips to the various fields.

Eggs commenced coming in on the 13th of April, and by the end of that month 105,364,000 had been secured; the collections during one night amounted to 22,539,000. The largest number of shad eggs ever collected in the Commission heretofore within twenty-four hours was a little over 8,000,000, in the spring of 1888, at this station. The take

in April exceeded the total number ever secured at any of the shad stations of the Commission in a single season, the largest heretofore recorded being 105,125,000 at Battery during the year referred to above. Work continued uninterruptedly until June 9, the collections in May aggregating 95,510,000 and in June 9,118,000, making a total of 209,992,000 for the season. Of these, 140,337,000 were purchased from fishermen at $20 per 1,000,000; the balance was taken by the regular spawn-takers. The capacity of the hatchery was severely taxed from the beginning of the season on account of large collections during the first ten days, but the pressure was partly relieved by transferring eggs to Central Station, Washington. Car No. 3 was equipped as a hatchery and stationed at Perryville. The low temperature prevailing at this time, however, retarded development to such an extent that the hatchery was soon filled to overflowing, and it became necessary to plant large numbers of eggs on the spawning-grounds.

Table of shad-hatching operations at Battery Station.

Date.	Eggs received.	Eggs hatched.	Eggs shipped and planted.	Fry planted.	Date of hatching.	Temperature of air.	Temperature of water.
						°	°
Apr. 13	203,000				Apr. 23		53.5
14	676,000						
15	2,338,000						
16	706,000		1,936,000				
17	5,909,000	655,000	2,541,000	655,000	30	56.5	54.5
18	15,230,000	6,244,000	7,233,000	6,244,000	May 1	52.5	51
19	10,916,000	2,152,000	8,118,000	2,152,000	2	52.5	51
20	432,000						
21	8,285,000	70,000	5,891,000	70,000	3	52.5	51
22	2,507,000		2,410,000				
23	11,631,000	4,227,000	3,219,000	4,227,000	5	54.5	53
24	13,747,000	4,212,000	9,395,000	4,212,000	7	54.5	53
25	22,539,000	4,155,000	13,552,000	4,155,000	9	54.5	53
26	8,432,000	880,000	3,947,000	880,000	9	53.5	53
27	529,000		300,000				
28	328,000						
29	956,000						
May 1	956,000	434,000		434,000	10	55.5	53.5
2	1,407,000	850,000		850,000	10	55.5	53.5
3	13,674,000	8,555,000		8,555,000	10	55	53.5
4	15,588,000	2,605,000	12,093,000	2,605,000	11	55	53.5
5	18,230,000	1,315,000	16,045,000	1,315,000	12	56	56
6	3,685,000	1,360,000	1,103,000	1,360,000	13	56.5	57
7	1,056,000	360,000		360,000	14	58	58
9	401,000	25,000		25,000	May 15	59.5	58
10	2,066,000	1,515,000		1,515,000	15	64.5	54.5
11	1,892,000	1,570,000		1,570,000	16	64.5	61.5
12	1,665,000	1,335,000		1,335,000	16	64.5	62.5
13	2,374,000	1,377,000		1,377,000	17	65.5	63.5
14	1,402,000	596,000		596,000	18	64.5	63.5
15	2,066,000	1,318,000		1,318,000	20	69.5	65.5
16	2,204,000	1,563,000		1,563,000	21	70	72
17	3,451,000	2,185,000		2,185,000	22	70	66
18	5,337,000	3,625,000		3,625,000	23	70	62
19	1,974,000	1,090,000		1,090,000	24	70	62
20	4,950,000	4,625,000		4,625,000	26	71	67.5
21	1,439,000	1,395,000		1,395,000	26	66	67.5
22	4,214,000	3,691,000		3,691,000	27	66	64
23	2,061,000	1,628,000		1,628,000	28	67	68
24	1,124,000	927,000		927,000	29	66.5	66
25	517,000	179,000		179,000	31	67	68
26	90,000	80,000		80,000	31	67	68
30	1,687,000		1,635,000		June 1	67.5	71
June 1	1,196,000	1,078,000		1,078,000	5	70.5	70
2	2,380,000	2,150,000		2,150,000	7	71	72.5
3	1,508,000	400,000	1,051,000	400,000	8	72	72.5
4	1,147,000	100,000	972,000	100,000	9	77	74
5	999,000	900,000		900,000	10	77	74
6	968,000	895,000		895,000	11	77	73.5
7	920,000	900,000		900,000	11	77.5	76
Total	209,992,000	73,221,000	91,444,000	73,221,000			

The weather was very cold during the early part of the season, the temperature from April 13 to 30 varying from 48° to 58°. About the middle of May it rose above 60° for the first time since collections commenced. These conditions, though not unfavorable to the collection of eggs, were unfavorable to their development. Many lots were held from 12 to 16 days before hatching, and the fry resulting from them were not only weak, but the percentage hatched was very small.

Particular attention was paid during the season to the spawning habits of the shad, with the view to ascertaining the character of river bottom most frequently resorted to in depositing their eggs. The investigations seemed to show that at the head of the Chesapeake Bay they prefer flats covered by débris, such as sticks and trees, and this theory accounts to some extent for the frequent changes of the spawning-grounds. The most successful fishermen select such places when in search of ripe fish, the collection of eggs forming an important part of their income late in the season, when fish sell for very little.

Attention is again called to the fact that large numbers of eggs of excellent quality were taken in the day—that is, from 4 a. m. to 4 p. m.

In addition to the eggs hatched at Perryville on car No. 3 and those transferred to Central Station, several shipments were made to Bristol, Pa., and, though sent in June, when the weather was quite warm, they hatched without material loss. Heavy losses were reported, however, on the shipments transferred to Central Station early in the season.

Striped bass were quite abundant during the spring, and some ripe ones were found. Two small lots of eggs were brought to the station, but they proved defective. A number of measurements were made of them, and in every instance they were found to be 0.125 inch in diameter.

In addition to the fish-cultural work, various repairs were made to the buildings, boats, and dock; 45 cases of herring roe were canned as fish food to be used at Wytheville and Craig Brook, and 3 half-barrels were salted for the same purpose.

The mean temperatures for the months of April, May, and June were: April, air 52°, water 50.5°; May, air 63°, water 62°; June, air 72°, water 72.8°.

Bryan Point Station, Maryland (L. G. Harron in charge).

During the summer and fall a hatchery with a capacity for 40,000,000 shad eggs was erected, under the direction of Mr. G. A. Schneider, at an expense of $1,000. The building is a one-story frame structure, 61 feet by 31 feet, and is equipped with six hatching-tables 16 feet long by 3 feet wide, and two tables 14 feet long by 3 feet wide, the larger tables carrying 32 jars each and the smaller ones 24.

Arranged around the sides of the building are rows of shelves for carrying eggs in open jars during the early stages of development, and fry tanks for holding the fry until they are ready for shipment. A commodious office and storeroom have been fitted up at the east end. The erection of this hatchery necessitating an increase in the pumping plant, a Worthington pump, of a capacity of 620 gallons per minute,

was transferred from Cape Vincent, N. Y., and the necessary water and steam connections were made during the winter by the engineer in charge. In addition to these improvements, a sea wall 140 feet long was built along the north side of the hatchery to protect it against the encroachments of the river.

In March preparations were commenced, under the direction of Mr. L. G. Harron, for fish-cultural work. A part of the force was taken on, and the steam launch *Blue Wing*, which had been rebuilt during the year, was placed in commission and transferred to the station. Tents were erected as usual for the accommodation of the crew, and by April 15 the station was ready for the reception of eggs. A few eggs came in on the 15th, 16th, and 17th, but the full force was not taken on until the 18th. The personnel, including the crew of the steam launch *Petrel*, which was also utilized for this work, consisted of 20 spawn-takers, 6 assistants in hatchery, 1 clerk, 8 men for the launches, 2 firemen, and 2 cooks. Operations were much interfered with throughout the season by severe storms and unseasonable weather. Heavy northeast gales occurred on April 20 and 27, accompanied by snow and rain, which stopped all work for several days. The laying of submarine mines on some of the best spawning-grounds in the vicinity of Forts Washington and Sheridan also curtailed collections considerably, and the establishment of the blockade at Fort Washington made it impossible to secure any eggs between there and Alexandria, as the launch was unable to go up and down the river at the proper times. The catch of fish was small, but the work was pushed so vigorously that by May 26 the total collections amounted to 68,724,000, nearly as many as were ever taken on the river. Of these, 4,448,000 were sent to Central Station; from the balance 47,366,000 fry were hatched and planted in the Potomac River between Broad Run and Occoquan Creek.

At the close of the season the temporary force was discharged, the station dismantled, and the launches transferred to other points.

With the experience gained this year it is believed that the collections at this station can be very materially increased and the work can be much more economically conducted with the new hatchery.

The following table shows the maximum, minimum, and mean temperatures of air and water from April 15 to May 25, inclusive:

April 15 to 30.	Air.	Water.	May 1 to 25.	Air.	Water.
Maximum	83	59	Maximum	88	73
Minimum	34	51	Minimum	52	55
Mean	59	55	Mean	69	63

CENTRAL STATION, WASHINGTON, D. C. (J. E. BROWN IN CHARGE).

As usual, all of the product of the Fish Commission ponds was distributed through this station, and consignments of lake trout, brook trout, Loch Leven trout, rainbow trout, and landlocked salmon eggs were transferred from other stations and hatched here, to illustrate the fish-cultural methods employed by the Commission.

The following table shows the number of eggs received and of fry hatched and distributed:

Species.	Number shipped.	Lost in transit.	Number hatched.
Loch Leven trout	9,950	98	7,282
Lake trout	25,000	239	22,140
Brook trout	10,000	72	8,556
Rainbow trout	10,000	38	7,948
Landlocked salmon	5,000	1	4,996

A larger amount of freight was handled during the year than usual, owing to the preparation of exhibits for expositions at Omaha, Nebr., and Bergen, Norway, 312 packages being received and 264 shipped out in addition to the regular freight and exclusive of the equipment belonging to the car and messenger service, which is stored here.

It having been determined to discontinue the hatching of shad eggs at this station on account of the construction of a hatchery at Bryan Point, the apparatus was dismantled and a portion of it transferred to Bryan Point, but the large collections necessitated the utilization of the station to a certain extent for this work. In April 1,525,000 eggs were received from the *Fish Hawk* at Avoca, N. C.; over 15,000,000 came in from Battery Station between April 20 and May 1, and 4,044,000 were sent up from Bryan Point. Owing to lack of facilities it became necessary to deposit 5,179,000 of the eggs in the Potomac River. The balance were hatched and the fry were planted in the Potomac except 3,537,000 which were transferred to the Fish Commission ponds.

AQUARIUM, CENTRAL STATION, WASHINGTON, D. C. (L. G. HARRON IN CHARGE).

The superintendent of the aquarium was detailed for duty at the Nashville Exposition from July 1 to September 14, and in March was placed in charge of the shad operations at Bryan Point, Md., where he remained until the end of May. He was again detached from duty in June and ordered to Omaha, where he remained until the close of the fiscal year.

As there was considerable difficulty in keeping the marine fish in healthy condition the salt water, which had been in use for several years, and which had received additions of artificial salt water from time to time, was discarded during the summer. The tanks were thoroughly cleansed and 6,000 gallons of salt water were brought from the Chesapeake Bay, in the vicinity of Old Point, Va. The usual collections of salt-water fishes were made in October at Old Point, 571 specimens, representing 33 species, being successfully transferred to the aquarium. The collection was further increased by consignments of sea-anemone and lobsters from Gloucester, Mass. All of these specimens, except a few which were bruised in transit, remained in the tanks to the close of the fiscal year. The only salt-water fishes that spawned during the year were two flounders, but the eggs did not hatch.

No difficulty was experienced in holding bass, goldfish, golden ide, and other fishes common to the Potomac River during the summer, and

in November consignments of brook trout, Scotch sea trout, steelhead trout, rainbow trout, quinnat salmon, Atlantic salmon, Atlantic salmon domesticated, and landlocked salmon were received from Craig Brook and Wytheville stations. These were carried until April 30 without material loss, when a heavy mortality ensued through the use of an excessive amount of alum in filtering the water. A few hundred of the rainbow, steelhead, and brook trout were saved, but they succumbed in June, when the water temperature reached 81°.

The large-mouthed black bass on hand at the close of the fiscal year have been in the aquarium for two years. When transferred from the Fish Commission ponds in June, 1896, they were between 2 and 3 inches long. They now measure from 9 to 12 inches.

The exhibit this year has been much more satisfactory than for several years previous, owing to the renewal of the salt-water supply and the installation of a large filter, which affords an abundance of clear water for the fresh-water specimens. The *Salmonidæ*, the basses, and most of the salt-water species are fed principally on round beefsteak, but their diet is varied from time to time by the use of live minnows.

The following is a list of the marine and fresh-water fishes and crustaceans exhibited during the year:

Marine species.	Marine species.	Fresh-water species.	Fresh-water species.
Croaker.	Pinfish.	Large-mouth black bass.	Goldfish.
Sea bass.	Black drum.	Small-mouth black bass.	Yellow perch.
Swellfish.	Dog shark.	Rock bass.	Sunfish.
Spadefish.	Red drum.	Brook trout.	English tench.
Tautog.	Spotted sea-trout.	Scotch sea trout.	White sucker.
Toadfish.	Pigfish.	Steelhead trout.	Chub sucker.
Sea-robin.	Pompano.	Rainbow trout.	Channel catfish.
Hog-choker.	White perch.	Quinnat salmon.	Yellow catfish.
Bluefish.	Burfish.	Atlantic salmon.	Leather carp.
Kingfish.	Star-gazer.	Atlantic salmon, domesticated.	Scale carp.
Blenny.	Scup.	Landlocked salmon.	Common eel.
Lizard-fish.	Lobster.	Crappie.	Paradise fish.
Spot or goody.	Blue crab.	Golden ide.	Mill roach.
Jumping mullet.	Spider crab.	Golden tench.	Tadpole.
Yellow-tail.	Hermit crab.		Terrapin.
Moonfish.	Shrimp.		Snapping turtle.
Flounder.	Diamond-back terrapin.		
Striped bass.	Sea-anemone.		

FISH COMMISSION PONDS (DR. R. HESSEL, SUPERINTENDENT).

As large numbers of young bass were destroyed by the *Notonecta* and the *Ditiscus* during the spring and summer of 1896, the crop available for distribution in the fall was smaller than that of the previous year, though operations had been conducted on a larger scale. During September and October 14,222 large-mouthed bass, 1,837 small-mouthed bass, and 779 crappie were shipped.

Early in April the breeding bass were transferred from the retaining-ponds to the spawning-beds in the north and south ponds and Nos. 6 and 7, the south pond being devoted exclusively to the small-mouthed variety. Artificial nests were placed in convenient places, and also piles of gravel for making natural nests. The first nests with eggs were discovered in the south pond on April 26, and on the following day a number of nests containing eggs were noted in the north pond.

Fry were observed within three or four days, and by the end of the month the fish had nearly finished spawning. The temperature during this period varied greatly, but the results were not injurious, apparently, as only four nests appeared to be affected with fungus.

The following shows the temperature of water on the spawning-beds from April 20 to 30, inclusive, taken at 7 a. m. and 4 p. m:

Date.	North pond.		South pond.		Date.	North pond.		South Pond.	
	7 a. m.	4 p. m.	7 a. m.	4 p. m.		7 a. m.	4 p. m.	7 a. m.	4 p. m.
	°	°	°	°		°	°	°	°
Apr. 20	58	64	58	58	Apr. 26	59	58	59	59
21	54	61	54	60	27	55	54	54	56
22	54	60	50	60	28	47	48	48	49
23	58	66	58	66	29	48	49	52	58
24	64	67	62	68	30	50	51	50	52
25	63	65	62	55					

As soon as the schools of young bass dispersed they were allowed to pass from the spawning beds to the main ponds, and the adults were again transferred to the stock ponds. The young fish were fed, as usual, on carp and tench reared for the purpose, from 400,000 to 500,000 carp a few days old and a large number of tench being placed in the north and south ponds during the season. At the close of the fiscal year the indications were that the crop of bass would be large, but it was impossible to form any definite idea of the number in the ponds on account of the dense growth of algæ.

In October the shad placed in the west pond during the previous spring were liberated in the Potomac River as usual. The number released was estimated at about 3,000,000. In May, 1898, another consignment of 3,537,000 were put in the same pond to be reared.

Some attention was paid this season to the propagation of frogs. A number of adults were placed in Pond 19 during the spring, and at the close of the year there were 4,000 young ones. Their hind legs had developed, but the fore legs were not yet visible. They were taking food freely. The old frogs live on bumble-bees, dragon-flies, ordinary flies, beetles, and moths that come within their reach over the grass borders. A number of the tadpoles were transferred to the aquarium in Central Station, and it was found that they would take cornmeal readily. It is intended to continue these experiments in the future in the hope that some useful information may be gained with reference to the culture of frogs in ponds.

The pond which had been stocked with fresh-water shrimps from North Carolina was examined during the fall of 1897 and 5,400 were found. Twenty-five of them were removed to a tank in the greenhouse and were carried through the winter in excellent condition. No trace of the others could be found in the spring, and it is thought that they were killed by the severe frosts.

Notwithstanding the efforts during the past two years to eradicate injurious plants and insects from the ponds by drawing off the water

and exposing the bottoms to frost, the condition of the north and south ponds was worse this year than ever before. The muddy sediment on the bottom was removed during the fall to a depth of 5 inches, and though a careful examination of the soil in March seemed to indicate that every trace of the injurious material had been removed it appeared in larger quantities than heretofore.

WYTHEVILLE STATION, VIRGINIA (GEORGE A. SEAGLE, SUPERINTENDENT).

Operations at this station were confined chiefly to the propagation and distribution of rainbow trout. In September the superintendent was detailed to make an investigation in Georgia for the selection of a suitable site for a fish-cultural station. This work, with reports, etc., occupied his entire time for that month. At the beginning of the fiscal year the stock of brood-fish on hand was as follows:

Species.	Calendar year in which fish were hatched.				
	1897.	1896.	1895.	1894.	1893 or before.
Rainbow trout	181,000	2,000	870	515	2,300
Quinnat salmon	4,200	.....	.....	.....	.....
Black bass, small mouth	.....	.....	.....	12	.....
Black bass, large-mouth	.....	.....	34	26	.....
Rock bass	.....	.....	.....	.....	145
Crappie	.....	.....	.....	.....	45

Of the rainbow trout, 61,000 fry were distributed during July and August, and the balance, 110,000, in November and December. These fish were carried during the summer in the rearing troughs and ponds, and fed on a mixture of beef liver and mush. About 12 pounds of this food were fed daily to 1,000 adult fish, and about ¾ pound to the same number less than a year old. The adults were fed twice a day, half of the above-stated amount being given at each feed. The small fry were fed four times a day on liver and mush, canned herring roe, and salted cod roe alternately. They were first trained to take the canned herring roe, and their diet was then varied by salted cod roe and liver. If the fry are first given the liver, it is afterwards difficult to induce them to take the roe.

In July, 1897, small samples of a prepared food, believed to be dried shrimp ground up, was sent to the station on trial by Mr. A. Voight, of Brooklyn, N. Y. The material in one parcel was finely ground, that in the other was coarser. Both samples were fed to the fingerlings, as there were none smaller at that time. The fish took no notice of the finely ground food, but of the coarser probably half was consumed. It is believed that small trout could be trained to take this food, and that it would be wholesome for them, though, perhaps, too expensive for use.

Of the total stock of adult fish, only 503 females produced eggs during the year. The spawning season commenced earlier than usual—on November 8—and continued until February 10. The total number of the eggs collected was 410,000, an average of 815 per spawner; for the fertilization of these, 320 males were used. The loss of eggs, owing to

imperfect fertilization and to other causes, was 23 per cent of the total number taken. Of the eyed eggs, 190,000 were shipped to foreign applicants and transferred to other stations; the remaining 124,000 were hatched at the station.

In April and May all of the fry on hand were transferred to Erwin Station, Tennessee, in order that the work of remodeling the ponds and making additions to the hatchery might be commenced.

In the spring the adult black bass and rock bass were placed in the spawning-ponds, but, owing to their poor condition, it is doubtful whether any results will be secured.

At the close of the season the stock of fish on hand was as follows:

Species.	Calendar year in which fish were hatched.				
	1898.	1897.	1896.	1895.	1894 or before.
Rainbow trout	6,446	3,450	844	700	1,500
Black bass, small mouth	.....	.....	.....	.....	7
Black bass, large mouth	.....	45	.....	34	20
Quinnat salmon	2,500	.....	.....	.....	.....
Crappie	.....	.....	.....	170	.....
Rock bass	.....	.....	.....	.....	85
Carp	.....	.....	.....	.....	20

In the fall the volume of water flowing from the spring decreased to such an extent that a loss of 800 two-year-old rainbow trout was sustained. As it was believed that the water escaped through subterranean passages, an effort was made to stop this waste by making a cut in front of the spring and filling it with stone and cement. At some points it was necessary to dig down 15 feet. The holes and sides were then tightly packed with clay, and the ditch filled with stone laid in cement. The wall thus formed was 4 feet thick at the bottom, 2 feet at the top, and capped with a cut stone 6 inches. As a result an increase of 100 gallons of water per minute was obtained.

The title to the station property having been satisfactorily adjusted during the winter by the legislature of Virginia, the appropriation of $10,000, made by Congress in 1896, became available in March. The work of repairing and remodeling the ponds was at once commenced, and by the end of June nineteen ponds had been constructed and the old residence removed.

ERWIN STATION, TENNESSEE (S. G. WORTH, SUPERINTENDENT).

On August 4 Mr. S. G. Worth, who had been appointed superintendent of the station, took charge, relieving Mr. W. F. Hill, who had been in charge of the construction. Work on the hatchery, dwelling, and ponds was pushed vigorously during the summer, and on October 20 the hatchery building was turned over to the Commission by the contractors. During the fall the troughs were constructed and placed in position, and in December the water supply was turned on in the hatchery. The large ponds at the station having been completed in November, arrangements were immediately made for collecting wild brook trout from streams in the vicinity for brood stock.

During November and December 2,989 fish, ranging from two to four years old and from 5 to 13 inches in length, were obtained and delivered at the station without loss at an expense of $367.80. No difficulty was experienced in making this collection, as numbers of streams within 40 or 50 miles of the station are well stocked with trout. As an illustration, in Higgins Creek, about 12 miles southwest of Erwin, 600 were taken in a stretch of less than 2 miles. The fish collected were hauled across the mountains to the station in wagons, and though many of them were en route two days but one fish was lost. They were placed in the large ponds, and though examined frequently no eggs were secured. It is presumed that the ripe fish spawned on the gravel bottom around the springs boiling up in the bottom of the pond.

The exact number on hand at the close of the year is not known, but many were lost. It is believed that the mortality was largely due to the depredations of cats, to which the brook trout, lying during the night in shallow water near the shore, fell an easy prey. The wounds were usually found on the back of the neck near the gill-covers and on the sides as far back as the first dorsal fin. The cats, when discovered to be enemies of the fish, were killed.

In February 100,000 brook-trout eggs were received from East Freetown, Mass., and although the loss during incubation and the early fry stages was apparently small, when the fish were transferred to the ponds on June 9 there remained only 11,562 by actual count.

During December 1,826 yearling rainbow trout were received from Wytheville and placed in one of the ponds. These fish have not done well, quite a number having died during the season; a large proportion have become very dark in color, and many of them are blind. The eyes protrude gradually, and are sometimes seen outside of the socket. The fish are apparently in good condition otherwise, fat, and without external wounds. No explanation of this condition can be furnished, but there is an impression among the people in the vicinity that rainbow trout have a tendency to become blind when introduced into the large springs of this section.

Two well-authenticated cases have been reported: General Wilder placed 14 adult rainbow trout obtained from Wytheville in a large spring near Elizabethtown, Tenn., and in a short time every one was blind. Another lot, placed in a large spring near Erwin, suffered the same fate. The blindness among the station fish occurred in ponds which had springs at the bottoms. The brook trout were not affected in this way except in a few instances where they worked their way into the reservoir; all fish entering the reservoir showed these symptoms, and died. The presence of minerals in the water may cause this difficulty, but it more probably results from the settling of air bubbles or grit on the mucous coating of the eyeballs. The water contains an immense amount of air, bubbling from the springs and buoying up the fine gravel and sediment unnaturally in the water. The reservoir water always contains sediment in suspension.

During the winter 50,000 rainbow-trout eggs were received from Wytheville. These were hatched, and on April 23 there were on hand 21,200 fry. In addition to these, 81,300 rainbow-trout fry were transferred from Wytheville during the month of April and held in troughs until June 7, when they were transferred to ponds, and were found by actual count to have been reduced to 51,899. There remained on hand at that time, from all sources, 73,099. At the close of the year all of the fish were doing well, though those transferred from Wytheville were much smaller than the station fish. It is believed that a considerable number of the fry were destroyed by snakes. As soon as their presence was suspected a temporary fence was placed around the ponds; in a week 5 water-snakes had been killed, and over 100 were killed during the year.

Much difficulty was experienced during the winter in procuring a sufficient amount of suitable food. All of the beef liver available in Erwin and Johnson City was purchased at prices varying from 5 to 8 cents per pound, but the supply was uncertain, and in April arrangements were made for securing regular supplies from Armour & Co. in Norfolk, Va. Whenever the shipments failed a mush, consisting of flour, eggs, sorghum, water, and salt, was used.

In the coldest weather, with snow and ice on the ground, the air was swarming with mosquito-like insects. There are also myriads of aquatic worms on all objects in the water here, and several varieties of *Gammarus* were seen in the supply ditch when the loose mud was being thrown out, though none have been noted in the ponds. Snails are exceedingly abundant, and the trout seem to feed on them; as they reproduce at an enormously rapid rate, there will probably always be plenty of food of this character.

The principal aquatic plant known in this region is the so-called branch lettuce, which spreads its roots under the shallow water or in wet mud. This remains green throughout the winter. During the cold season its leaves lie flat on the water, like lily pads, but in summer the seed stalks rise to the height of 2 feet. The submerged leaves and branches serve as nurseries for periwinkle and other lesser forms of animal life. Quantities of wood or leaf mold were used for the purpose of disinfecting the ponds and establishing natural conditions. In order to procure natural food for the larger fish a lantern with metal wings, to lure beetles and moths, was placed in the pond; striking the metal walls, the insects fall upon the water and become an easy prey for the trout. While the supply of food thus derived has not been great, better results are looked for during the summer and fall, when such insects will be very plentiful. When the water was turned on in the temporary pond built in the bed of the branch, which had been lined with mud, myriads of jointed red worms, about half an inch in length, were seen at the bottom, massed together here and there.

The temperature of the water in the spring is 55° throughout the year. In the ponds there is a variation of from 55° at the bottom to

71° at the surface. During the winter, though the temperature of the air reached zero, no ice was formed in the reservoir, ponds, or ditch.

During the spring the station grounds were overrun with stray dogs and cats, and with a view to checking this influx all of the discarded food was buried. This measure apparently had no effect, and it became necessary to destroy all intruders of this character found on the grounds. Frogs of all kinds were also abundant, and it became necessary to destroy many of them. The food frogs were removed from the station grounds and placed in a stream below the railroad. In May and June tree frogs were spawning in large numbers in the ponds. Kingfishers were often observed, although few were killed. Snapping turtles were noticed occasionally while the ponds were being excavated, but not in great numbers. The miller's thumb is abundant.

While engaged in the construction of the station the superintendent was the recipient of valuable assistance from residents in the vicinity, officials of the Ohio River and Charleston Railroad, Mr. Dana Harmon, attorney-general of the first Tennessee district, and Mr. P. L. Haun, sheriff of Unicoi County, through whose cooperation the collection of wild trout from the streams of eastern Tennessee was made possible, as the laws of the State forbid the capture of trout during the fall months.

PUT-IN BAY STATION, OHIO (J. J. STRANAHAN, SUPERINTENDENT).

With the view to increasing the collection of whitefish eggs on Lake Erie, for restocking the waters of this lake and supplying the hatcheries on Lakes Ontario, Huron, and Superior, it was determined, in addition to collecting eggs, as heretofore, from the nets fished in the western end of the lake, to pen large numbers of male and female fish and hold them until ripe, as it was believed that, if this method proved feasible, the collections of eggs would be limited only by the number of fish caught. Under the old system severe gales during the height of the spawning season reduced the collections from 30 to 50 per cent, notwithstanding the fact that nearly as many fish were caught over the same area as usual, and though nearly the same amount of money was expended in the work. Arrangements were made with a number of fishermen in the vicinity of Put-in Bay and Bass Islands to obtain the fishes desired, holding them in crates until the close of the season, when they were to be returned to the fishermen.

During October, when we had anticipated securing many fish, the weather was so unfavorable that they did not arrive on the spawning-grounds for at least two weeks later than usual, and none were secured until November 8, and these were taken under adverse circumstances. Collections continued until November 27, when all of the nets were removed. The total number secured was 1,247, and 1,119 of these were transferred to live-boxes or crates. Of the 334 females, 260 were available as spawners and produced 10,269,000 eggs, an average of 39,496 to the fish. The balance of the females were "plugged" or died from injuries. The disproportion of sexes was due to the fact that large numbers of males were penned early in the season on the suppo-

sition that the later run would contain more females than males. The eggs secured from the penned fish were of fair quality, though not as good as those collected during a favorable spawning season. With the experience gained there is little doubt that in the future much larger and better results will be secured. The eggs collected from the penned fish cost $1.20 per quart, or 3⅓ cents per 1,000; those taken directly from the fish captured in the usual manner cost less than 2 cents per 1,000. This is exclusive of the cost of the live-boxes, pens, nets, etc., which are on hand and available for work in the future. It is easily understood that ten times as many eggs could have been collected at the same expense as the number referred to, in which event the cost would have been less than 1 cent per 1,000.

The following is a brief description of the methods employed in collecting and penning the fish and of the apparatus used: Stationary live-boxes, supported by piling, have often been used, but as the water at Put-in Bay becomes too warm for this, the boxes were made so that they could be towed, like a raft, into open waters where the current is more vigorous and the temperature more uniform; another advantage gained by this method is that an equal depth of water is maintained in the live-boxes, the rise and fall in this section varying from 4 to 5 feet in a single day, according to the direction and velocity of the wind and the atmospheric pressure. The boxes are 16 feet long, 8 feet wide, and 8 feet deep, divided into two equal compartments 8 feet square, provided with false bottoms controlled by standards running in guides at the ends. The standards are pierced by inch holes at intervals of 6 inches, so that the false bottoms may be held at any desired place. The lumber used was 6-inch pine boards planed on the inside and nailed to scantling 1¼ inches apart, so fastened together as to make every side interchangeable. The six boxes, divided into twelve compartments with a capacity for 4,500 fish, were fastened at the ends to boom logs 65 feet long, with plank walks on both logs, thus permitting free access to all parts of them.

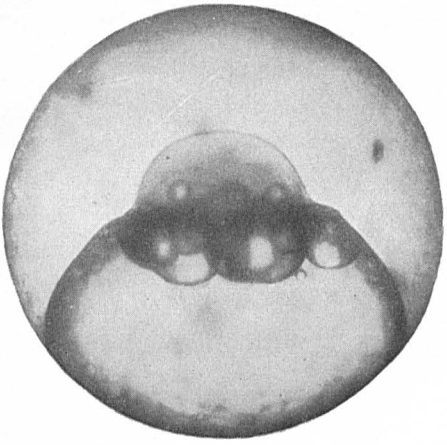
Owing to the difficulty experienced in transferring the fish from the pound nets to the boxes, on account of rough weather, supplemental nets 7 feet long and 3 and 4 feet in diameter were placed at each pound net where fish were expected; these were held open at top and bottom by iron rings, and the bottoms were provided with puckering-strings for closing them. By fastening one side of these nets to the down-haul stake and the opposite one to the rim of the pot of the pound, the upper ring is held 3 feet above the surface of the water and the lower one 4 feet below, serving as a weight to keep the net down and also to keep it open, so that the fish will have plenty of room and not be scaled by chafing against the net. Thus located, the supplemental net is in convenient position for receiving the fish when the pound is lifted. By the use of these nets it became possible to secure many more fish than otherwise. During the past season fish were collected from six sets of nets with an equal number of boats, aggregating 55 pound nets. An employee of the Commission was placed in each boat, to dip out the fish

and put them in the supplemental nets, and also to collect the eggs from ripe females. The dip nets used for taking the fish from the pounds have long handles and hoops of spring steel, and are covered with heavy open cloth such as is used in the cider press, as the knots and twines of the ordinary net would injure the scales of the fish.

The steamer visited the supplemental nets daily when the weather permitted, and removed the fish to spacious tanks on board, then transferring them to the station, where they were counted and assorted. It is necessary to exercise much care in this work, as success is entirely dependent upon the fish reaching the live-boxes uninjured. Before placing them in the boxes they are assorted into three classes—soft, medium, and hard. The soft ones (those nearly ripe) are examined each day; the medium every third or fourth day, and the hard ones at the end of each week. In this way much unnecessary handling is avoided and the fish are kept in good condition. At the close of the season all were returned to the fishermen in excellent condition.

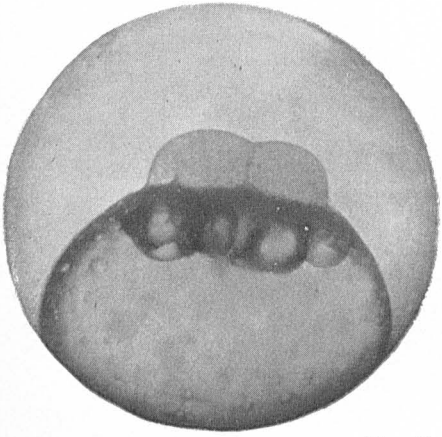
Spawn-taking is conducted under a temporary shelter erected on a raft, and does not differ materially from the mode generally pursued. The last fish were removed from the live-boxes on December 13, when six of them were placed in one of the fry-tanks at the station for future experiment. One of these was what is known as a "plugged" female; that is, her abdomen remained hard and showed a congested condition. This specimen was killed and opened. The ovaries were found to be congested and the eggs, when examined under the microscope, all showed ruptured yolks. Two of the other fish were apparently healthy females containing spawn, and two were healthy males. These were held in the fry tanks until December 21, when the females were found to be ripe. In fact, one of them had cast most of her eggs in the tank. From the other nearly a quart of spawn was taken.

The eggs were fertilized with milt from one of the males and presented a very good appearance, though it was noticed that they were a little undersized, running 10 to the linear inch instead of 8. The temperature of the water at the time being 32.5°, the eggs did not show distinct segmentation at the end of the first 24 hours, and they were not therefore critically examined until they were 48 hours old, when it was discovered that 90 per cent of them were impregnated, but over half of them seemed abnormal, the discs being spread out more than usual and many being segmented in patches or clusters. They were again examined on the 24th, and it was found that 10 per cent of them plainly showed well-defined twin discs, and three triplicate discs were discovered out of some 500 eggs examined. They were kept under observation from day to day, and micrographs taken. It was also observed that there were many eggs in this lot containing insufficient yolk-sacs. This led to an examination of several other lots of eggs taken late, which in turn revealed the fact that the late eggs contained a much larger percentage of insufficient yolks than those taken earlier in the season. It has been noticed each season since this station was established that the late eggs did not turn out as well as those taken at the

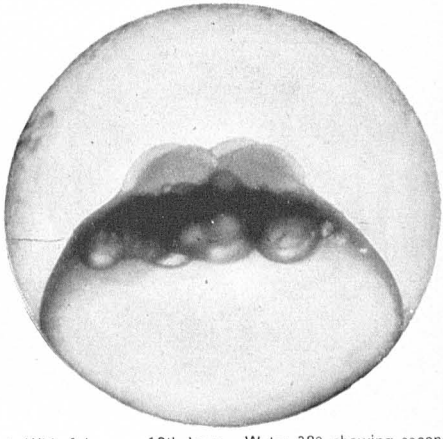


1. Unfertilized whitefish egg 24 hours old.

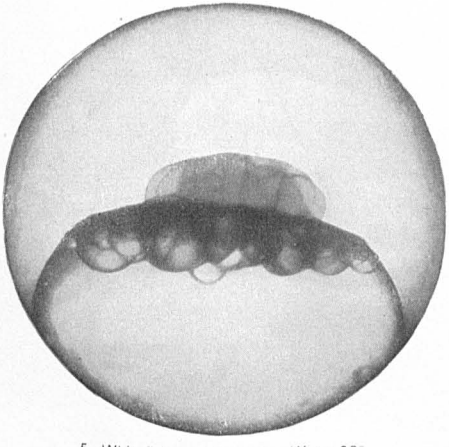
2. Fertilized whitefish egg 6 hours old, geminal discs forming, no segmentation having taken place.



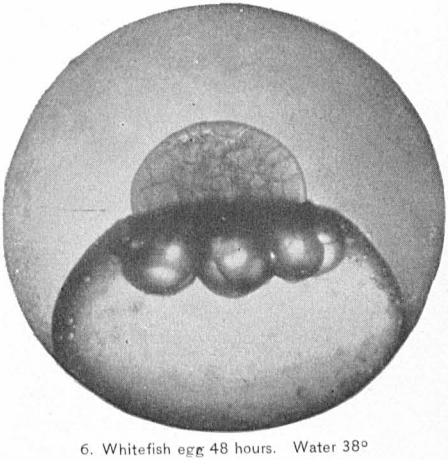
3. Whitefish, 12 hours, showing first cleavage. Water 38°.



4. Whitefish eggs, 18th hour. Water 38°, showing second segmentation, four cells formed.



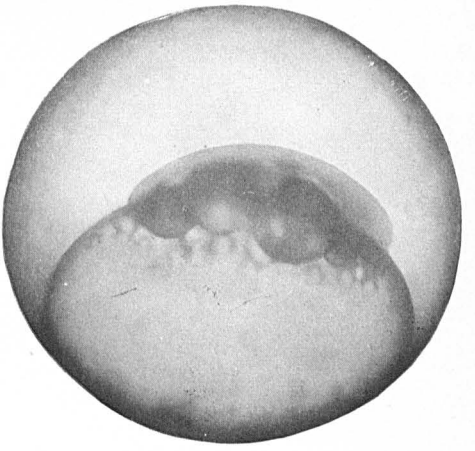
5 Whitefish egg 24 hours. Water 38°.



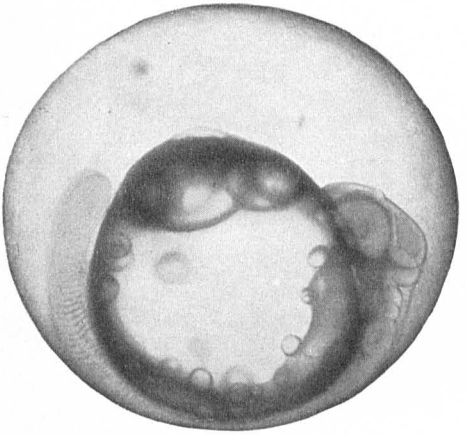
6. Whitefish egg 48 hours. Water 38°

DEVELOPMENT OF THE WHITEFISH EMBRYO

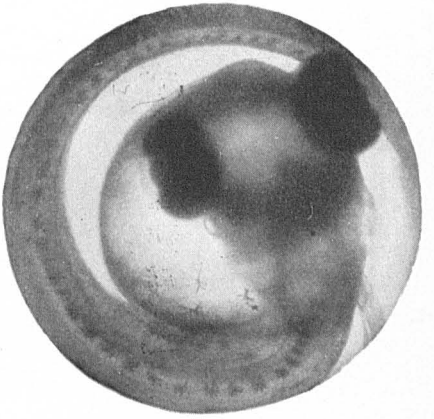
7 Fertilized whitefish egg 72 hours old, showing segmentation well advanced.



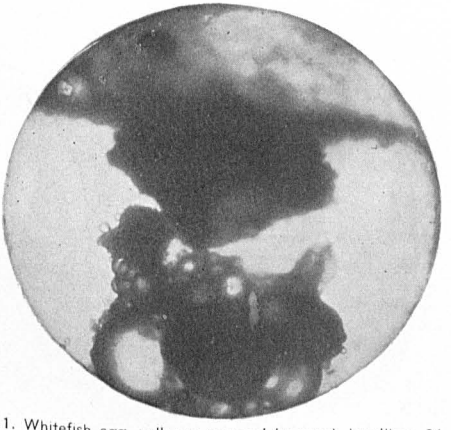
8. Whitefish egg, seventh day, embryo beginning to show.



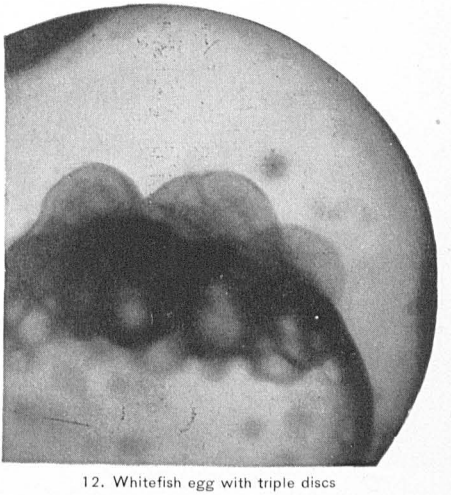
9. Whitefish egg 43 days old, showing embryo.



10. Whitefish 90 days old, showing embryo.

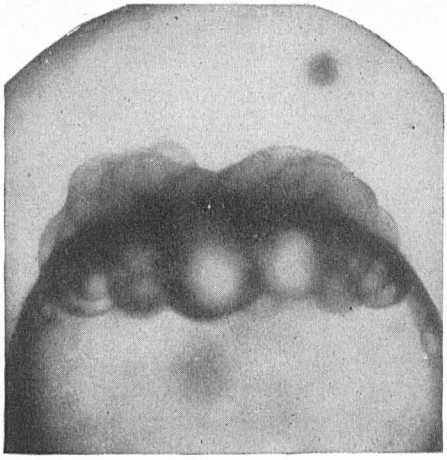


11. Whitefish egg, yolk-sac ruptured by rough handling, 24 hours old.

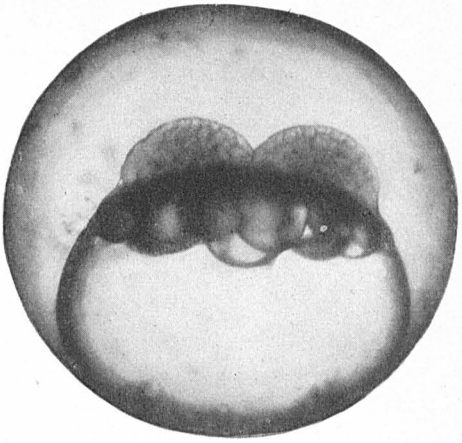


12. Whitefish egg with triple discs

DEVELOPMENT OF THE WHITEFISH EMBRYO.

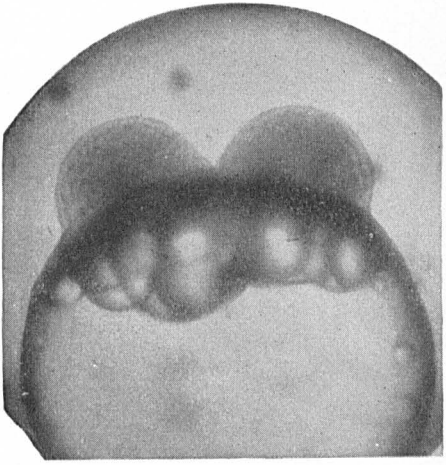


13. Whitefish egg, showing twin discs, 3 days old

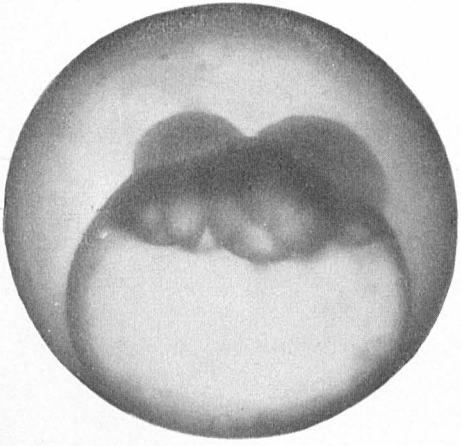


14. Whitefish egg, showing twin discs, 6 days old.

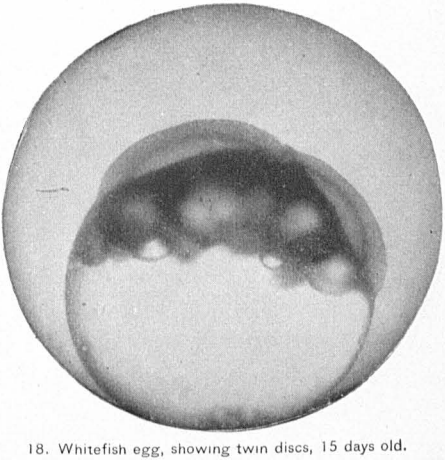
15. Whitefish eggs, showing twin discs, 7 days old.



16. Whitefish eggs, showing twin discs, 8 days old.

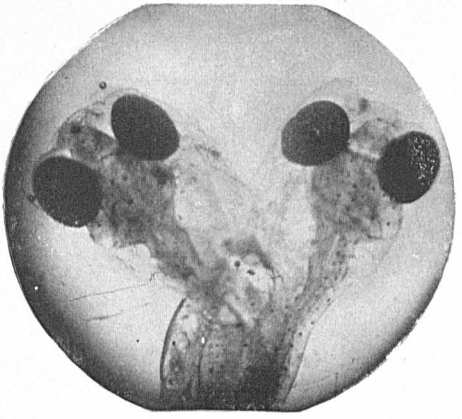


17. Whitefish egg, showing twin discs, 13 days old.

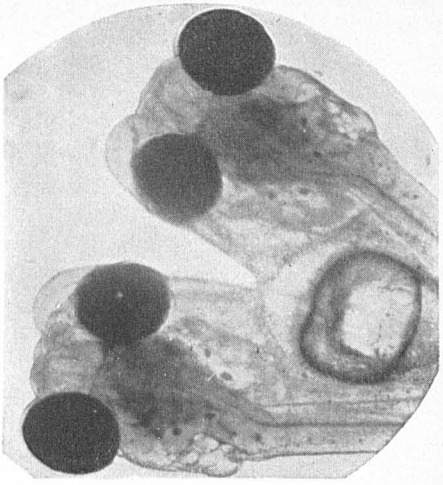


18. Whitefish egg, showing twin discs, 15 days old.

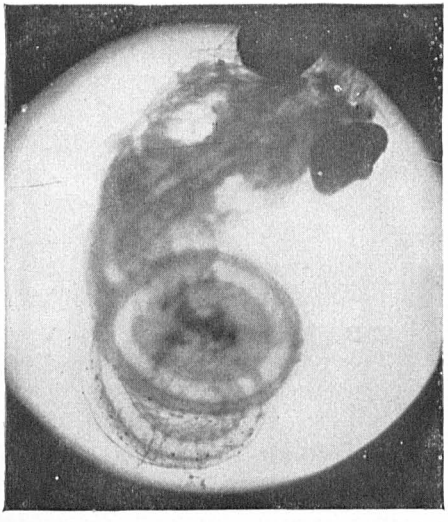
DEVELOPMENT OF THE WHITEFISH EMBRYO.



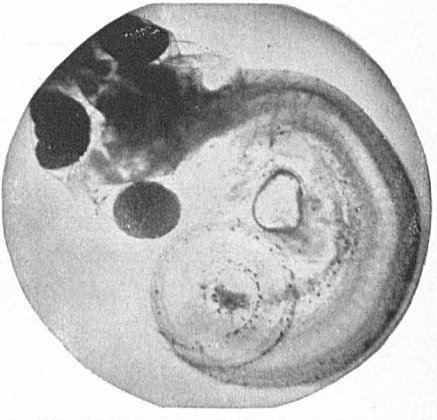
19. Double-headed whitefish fry just hatched.



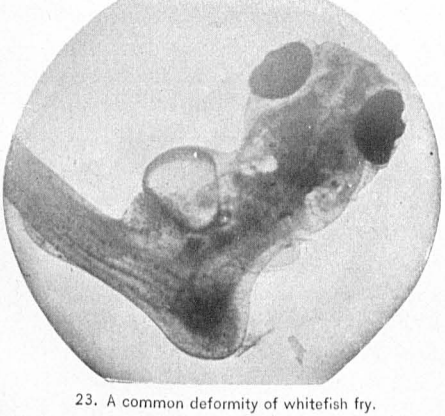
20. Double-headed whitefish fry.



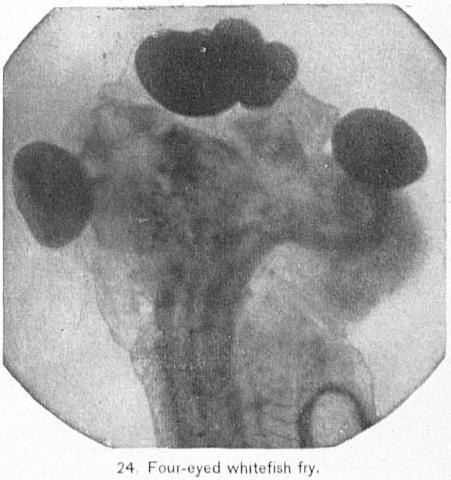
21. Curved spine, a common deformity of whitefish fry.



22. Whitefish fry just hatched, three-eyed, curved spine.



23. A common deformity of whitefish fry.



24. Four-eyed whitefish fry.

DEVELOPMENT OF THE WHITEFISH EMBRYO.

height of the season. It may be stated that no twin discs were found among the other lots examined, although after the above experience it had been confidently expected to find them. Never before, however, has a twin disc been observed in a whitefish egg, and only three were found this season outside of the lot under consideration; neither have twins or double-headed monstrosities been found common among the whitefish fry, though they are common among the lake trout.

The development of this lot of eggs was watched with much interest, but on January 10, when the embryos began to form, not a single twin or double-headed one could be found. It was observed, however, that 20 per cent of the eggs were far behind the rest in point of development and, though apparently alive and healthy, there was no sign of embryotic formation. This went on until January 26, when two well-defined double-headed embryos were discovered. From this on they were found in numbers, though very few of them had two perfect heads, and there were no well-marked twins—that is bodies entirely separated except by their attachment to the yolk-sac, as is so common with trout. Most of the monstrosities had one normal and one abnormal head. It is worthy of note that the perfect head was, without a single exception, on the left side, and where both were abnormal the left one was the better of the two, as will be noted in the accompanying micrographs.

Since writing the above Superintendent Stranahan has learned, by consultation with Prof. Jacob Reighard, of the University of Michigan, that in his opinion the large number of abnormalities found among these eggs was caused by their being held long past the normal time of deposit. His experience showed that this is likely to be the case with amphibians held in confinement. This may furnish the reason why late eggs show more monstrosities than those taken early in the season.

The penning of whitefish near the station this season has afforded exceptional opportunities for experiment with the fertilization and development of the ova, and considerable attention has been paid to the determination of how long milt will retain its vitality after being mixed with water. On December 4 a quantity of spawn, just as it was taken from the fish, was brought to the station, and a small quantity placed in each of 16 perfectly dry, clean pans, which were set in running water at a temperature of 36°. The milt of three males brought alive to the station in a tub of water was taken in a dry pan, care being exercised that no water dripped from the fishes into the pan. Water was then added, and a portion poured into one of the pans containing eggs, numbered 0. In a quarter of a minute another portion was poured into the pan numbered 1, and so on to the finish. After each lot had stood one minute the eggs were washed and placed in kegs in running water, with numbers to designate each lot. On December 5, the eggs, being well segmented, were carefully examined under the microscope, to determine the percentage of impregnation. In each case those with ruptured sacs, or those destitute of germinal disks were not taken into account, the object being to determine the percentage of impregnation at the different periods.

The following table shows the percentage of impregnation in each lot:

Time.	Per cent.	Time.	Per cent.	Time.	Per cent.	Time.	Per cent.
0 minute	99	1 minute	93	2 minutes	14	3 minutes	7
¼ minute	98	1¼ minutes	77	2¼ minutes	18	3¼ minutes	3
½ minute	99	1½ minutes	47	2½ minutes	8	3½ minutes	2
¾ minute	96	1¾ minutes	19	2¾ minutes	6	3¾ minutes	2

On December 8 the experiment was repeated with, if possible, more care than on the previous occasion. It was carried further, to determine the point at which absolute loss of vitality would take place. The following table shows the result, the temperature of the water being 35.5°:

Time.	Per cent.	Time.	Per cent.	Time.	Per cent.	Time.	Per cent.
0 minute	98	1¼ minutes	49	2¼ minutes	14	3¾ minutes	1
¼ minute	97	1½ minutes	2	2¾ minutes	15	4 minutes	0
½ minute	83	1¾ minutes	42	3 minutes	1	5 minutes	0
¾ minute	82	2 minutes	11	3¼ minutes	0	6 minutes	0
1 minute	83	2¼ minutes	14	3½ minutes	1	7 minutes	0

It will be seen that the eggs fertilized 1¼ minutes after water was added to the milt showed but 2 per cent alive, while those affected by the next period, a quarter of a minute later, showed 42 per cent. Although great care was taken to avoid mistakes, it is evident that there was one in this case, or that something in the pan caused the death of a great number of these eggs.

It frequently occurs that large numbers of eggs are lost during the latter part of the season, owing to the scarcity or entire absence of males when large numbers of ripe females are taken. To overcome this difficulty, experiments were conducted to determine how long milt and eggs could be carried alive separately and then fertilized. The milt of 5 males was taken in a vial which had been rendered chemically clean and dry. Great care was exercised in taking the milt, and to avoid the mixture of water, excrement, or other foreign substances, the mouth of the vial being held up close to the vent of the fish, and only such portion taken as came in a stream. The vial was then tightly corked and placed in running water in a pan, so as to secure a temperature as nearly that of the fish as possible. This milt was taken at 10.45 a. m. on December 4. On the following day, at the same hour, a small amount of eggs was fertilized with this milt. An examination showed that the percentage of impregnation was as complete as would naturally be the case with fresh-taken milt. A series of experiments of the same character was continued for several days, the eggs being kept in clean pans in running water, light being excluded. All the milt was treated as the first lot, precautions being taken not to let water enter the vials when the corks were removed.

The following table is self-explanatory. In making the counts, all eggs with ruptured yolk-sacs or those destitute of germinal discs were disregarded, the object being to determine the percentage of impregnation. The examinations were as carefully made as practicable, 100 eggs impregnated and unimpregnated being counted for each lot below referred to.

On December 8 six lots were examined, as follows:

Date of examination.	Lot.	Date and hour of taking.		Date and hour of impregnation.	Per cent.
		Spawn.	Milt.		
Dec. 8	First	Dec. 7, 9.20 a. m	Dec. 4, 10.45 a. m	Dec. 7, 9.25 a. m	95
	Second	Dec. 6, 11 a. m	Dec. 6, 11.25 a. m	Dec. 7, 9 a. m	97
	Third	Dec. 6, 11 a. m	Dec. 4, 10.45 a. m	Dec. 7, 9 a. m	98
	Fourth	Dec. 7, 8.45 a. m	Dec. 7, 8.45 a. m	Dec. 7, 9.10 a. m	98
	Fifth	Dec. 6, 11 a. m	Dec. 7, 8.45 a. m	Dec. 7, 9.10 a. m	93
	Sixth	Dec. 7, 8.45 a. m	Dec. 6, 11.25 a. m	Dec. 7, 9.25 a. m	85
Dec. 9	First	Dec. 6, 11 a. m	Dec. 4, 10.45 a. m	Dec. 8, 1.15 p. m	3
	Second	Dec. 6, 11 a. m	Dec. 6, 11 a. m	Dec. 8, 1.15 p. m	91
	Third	Dec. 8, 1.20 p. m	Dec. 4, 10.45 a. m	Dec. 8, 1.25 p. m	6
Dec. 12	First	Dec. 11, 2 p. m	Dec. 6, 11.25 a. m	Dec. 11, 2.10 p. m	3
	Second	Dec. 6, 11 a. m	Dec. 11, 2 p. m	Dec. 11, 2.20 p. m	0
	Third	Dec. 11, 2 p. m	Dec. 9, 9 a. m	Dec. 11, 2.05 p. m	0
	Fourth	Dec. 11, 2 p. m	Dec. 4, 10.45 a. m	Dec. 11, 2.15 p. m	0
	Fifth	Dec. 11, 2 p. m	Dec. 7, 8.45 a. m	Dec. 11, 2.10 p. m	0

From these experiments it would seem that neither spawn nor milt retain their fertility after the third day; but this is not necessarily the case, as the milt used in all of these long-time experiments, with one exception, was from the lot of December 4, which had been repeatedly uncorked and possibly injured by the admixture of a small amount of water, while the spawn was held in small lots of a half pint or less, which were more liable to dry out than a large mass. All of the eggs used in this experiment, except one lot, were placed in a jar marked "miscellaneous," and examined from time to time, showing a good percentage of impregnation. Before being placed in the jars they were held separately in kegs for two or three days with running water and reexamined to observe if the development seemed natural, and no difference could be seen between these and eggs of the same age taken at the same time in the usual manner. It is a matter of regret that there were not enough taken at one time to fill a jar, so that they could have been carried separately up to the hatching period.

An experiment was also tried with a view to hatching whitefish eggs with closed circulation—that is, using the water over and over. The water was pumped into a 12-gallon keg, whence it descended by gravity to the jar, thence to a large tin vessel, which was partially submerged in running water in order to maintain a low temperature. From this it was again pumped back to the keg. This experiment was continued for 13 days without damage to the eggs, although, owing to the fact that the temperature of the water was 7° warmer than that taken from overboard, the development was much more rapid. It may also be stated that so much oil was carried over from the pump that it formed a considerable coating on the surface of the water in the receiving vessel, also on the inside of the jar. The eggs, however, were apparently not injuriously affected by this circumstance. These eggs hatched before any others in the house, and the fry were apparently as healthy.

Collections of eggs were made, as heretofore, from the commercial fishermen, but owing to the unfavorable conditions prevailing during November, the total collections amounted to only 112,842,000 whitefish and 27,786,000 cisco or lake herring. From the nets fished in the vicinity of Port Clinton, 40,653,000 whitefish eggs were obtained; from

those in the vicinity of Toledo, 21,348,000; North Bass Island, 21,762,000; Middle Bass field, 2,331,000; Kelly Island, 7,866,000; Catawba Island, 720,000; from Put-in Bay, 18,000,000 whitefish eggs and 27,786,000 of the eggs of the cisco; from other points, 162,000 whitefish eggs. Of these eggs, 10,000,000 were transferred to Alpena Station; the balance were hatched and distributed during March and April on the spawning-grounds from which the eggs were collected, the cisco fry being planted in the vicinity of Put-in Bay.

During the winter 1,000,000 lake-trout eggs were received from Northville, which were hatched and planted in the vicinity of the station.

It having been determined to resume the propagation of pike perch, steps were taken to secure a force of spawn-takers and arrangements made with the fishermen for attending the pound nets in the vicinity of Put-in Bay, Toledo, and Port Clinton. The warm weather in March raised the temperature of the water to 42.5°, which advanced the spawning season a week. The first eggs were taken on March 31, earlier than ever before in the history of the station. A small lot was brought in by the fishermen in this neighborhood. The regular spawn-takers were not put on until April 4. On April 5 a severe northeast gale set in, accompanied by snow, the temperature falling from 42.5° to 38°. This not only interfered materially with the work, but the eggs taken were poor. The weather continued unfavorable throughout the spawning season, gale following gale in rapid succession, which not only seriously reduced the collections, but affected unfavorably the work in the hatchery. The water pumped at the station was loaded with dirt, causing much extra labor and continual handling of the eggs. Dead eggs, which ordinarily fungus in a few days and are drawn off, were coated with dirt so that they were of the same weight with the others, and failed to rise to the top, necessitating not only constant handling, but the passing of the eggs through fine screens, in order to remove those which were fungussed.

As a result of the season's work, 221,062,500 eggs of poor quality were collected; 87,112,000 from the Toledo field, 111,900,000 from the Port Clinton field, and 22,050,000 from the vicinity of Put-in Bay.

In the beginning of the season starch was used to prevent adhesion of the eggs; but complaints were received from every section that this material was not satisfactory, as was proved by the fact that all of the eggs came to the station more or less adherent. Swamp muck, which had been used with success three years before, was substituted and sent out at once but, owing to delays en route the season was nearly over at Toledo before it could be used. Not more than 2 tablespoonfuls of the muck solution to 5 gallons of water was needed to prevent adhesion. Experience has also shown that it is advisable to put the muck in the water in the keg in which the eggs are poured after impregnation, rather than to mix it with the eggs in the pan prior to fertilization. If a small amount of water is added to the eggs immediately after fertilization and the milt washed out quickly, adhesion does not take place for a minute or two.

On April 16, near the close of the season, one of the spawn-takers, Mr. Carl Rotert, was directed to remilt the eggs taken on that date; that is, to add fresh milt one minute after first applying it to the eggs, and to add a third lot a minute later. In all, 450,000 eggs were treated in this way, and after careful examination under the microscope, at the expiration of twenty-four hours, out of the three lots of 150,000 each not an unimpregnated egg could be discovered. They were then put in a jar and kept thus to the close of the season. After the ruptured eggs had worked off (ruptured eggs fungus and separate from the good ones much sooner than the unimpregnated ones) the jar stood in striking contrast to the balance of the eggs in the house, a solid mass of living eggs. For some unaccountable reason they hatched before any of the others, though taken last. Instead of requiring several days to hatch, they all came out together, and the fry were apparently healthy, as seen under the microscope or with the naked eye. It is a matter of regret that this experiment was not tried earlier in the season, as it appeared from the results attained in this instance that previous heavy losses on pike-perch eggs may have been largely due to imperfect fertilization. This matter will receive attention next season, and experiments will be tried in remilting whitefish eggs also.

The eggs collected at Toledo were shipped on trays by the steamers running from Cleveland to Toledo three times a week, and although the eggs were held at least two days on the trays, they were apparently not injured by the shipment; 30,000,000 of the pike-perch eggs were transferred to Cape Vincent hatchery, and in order to decide as to the best method for long-distance shipments, a part of them were transferred on trays, and the balance in the ordinary transportation cans filled with water. Of those transferred on trays, only 30 per cent hatched, while of those shipped in water 75 per cent hatched. As eggs were successfully shipped on trays from Toledo to Sandusky, it appears that the loss must have been due to concussion, caused by the jolting of the cars, the eggs on trays being much more subject to this than those in water.

On May 2 it was observed that the eggs seemed unusually buoyant, and that they rose higher in the jars than usual with the same amount of water. Examination under the microscope revealed the existence of numerous colonies of infusoria, nearly every egg having one or more colonies. They were in the main a species of *Carchesium*, with a few *Vorticella*. These being lighter than the water, and offering considerable resistance to the current, floated the eggs. On the 3d they had increased to such an extent that it was necessary to put the eggs into tubs and thoroughly wash them. This process broke the slender threads which connect the individual infusoria to their main stem on the egg, and remedied the evil. Later it was found that by thoroughly feathering the eggs in the jar the same results could be secured. These animals were found in all the jars, there being no difference whether muck or starch had been used. Thorough investigation did not show that the eggs were damaged, directly or indirectly, by these infusoria.

Owing to the unfavorable conditions above enumerated, only 71,110,000 fry were hatched. These were planted in the waters of Lake Erie at the following points:

Point of deposit.	Number.	Point of deposit.	Number.
Peach Island reef	13,500,000	Niagara reef	10,320,000
North Bass Island reef	7,320,000	West Sister Island reef	10,320,000
Ballast Island reef	6,000,000	Rattlesnake Island reef	12,900,000
Middle Bass Island reef	10,750,000		

It is believed that the daily examination of eggs under the microscope will prove to be an important factor in the future operations of the station, as it is thus possible to keep track of the work of individual spawn-takers, poor results being very frequently due to carelessness in handling the eggs. The superintendent made photomicrographs of the normal impregnated egg showing segmentation, of the unimpregnated egg showing the germinal discs with no nodules of segmentation, and of an egg with ruptured yolk-sac, destroyed by rough handling. These were sent to the spawn-takers, so that they could understand how easily the three classes of eggs are distinguished one from the other under the microscope.

During the year a number of improvements were made to the grounds and in the adjacent harbor. A sea wall, 115 feet long and from 4 to 6 feet high, was constructed on the south side of the hatchery parallel with the shore line, and the space back of it filled in with dredgings from the lake bottom in front. The ground was graded and seeded and beds of plants set out, improving greatly the appearance of the station. The space adjacent to the docks was also dredged out, so that the steamer could come in and out at low water, and also to provide sufficient space for wintering the vessel.

The following table gives the maximum, minimum, and mean temperatures of air and water in the hatchery during the year:

Month.	Air.			Water.			Month.	Air.			Water.		
	Max.	Min.	Mean.	Max.	Min.	Mean.		Max.	Min.	Mean.	Max.	Min.	Mean.
1897.							1898.						
July	98	65	78.44	82	71	76.90	January	55	11	30.87	33.25	32.5	32.58
August	82	62	70.2	81	68	72.8	February	58	— 4	28.45	32.5	32.5	32.5
September	84	51	62.6	73.5	62	68.2	March	64	20	40.30	42.5	32.5	35.57
October	76	44	56.93	65	54	55.7	April	63	23	45.53	49	38	43.95
November	55	22	37.71	54	36	41.5	May	75	44	60.74	66	48.5	56.90
December	54	11	29.82	37.5	32.5	33.57	June	89	60	72.15	75	64	70.23

NORTHVILLE STATION, MICHIGAN (F. N. CLARK, SUPERINTENDENT).

During the summer the station employees were occupied in improving the grounds, painting and repairing the fish-cultural apparatus, and caring for the fish on hand. Early in September the lake trout carried through the summer were distributed in Lakes Huron, Michigan, Superior, and interior lakes. As the cars of the Commission were occupied at other points at this time, the distribution was made by means of a baggage car, obtained through the courtesy of the officials of the

Flint and Pere Marquette Railroad. Although the fish were planted without loss, the use of baggage cars for this purpose under ordinary circumstances is not deemed advisable, as they are not equipped for transportation on fast trains.

Early in August the superintendent visited the important fishing centers on Lakes Superior, Huron, and Michigan to make arrangements for the fall work. As a law had recently been passed by the State legislature prohibiting all fishing for lake trout and whitefish between November 1 and December 15, no efforts were made to secure eggs of the latter species. Messrs. H. H. Marks and George Platts were put in charge of the field operations, as the regular foreman, Mr. S. W. Downing, had been detailed to assist in the salmon work on the Pacific coast.

The first lake-trout eggs collected were received at Northville on September 16, but as the temperature was unusually high at the time of shipment they proved a total loss. Eggs continued to arrive all through October and until November 8, most of them being in excellent condition. The shipments aggregated 12,014,000, over 5,000,000 of which were taken in the Georgian Bay. Of the balance, 4,938,000 were obtained from the fisheries on the north shore of Lake Michigan near Manistique, within a period of ten days, 500,000 from the southern and 992,000 from the northern shore of Lake Superior.

The results from Lake Superior were disappointing, as large collections had been expected from that section. No efforts were made to attend the fisheries at Beaver Island, one of the most productive sections in past years, as the trout in that vicinity do not spawn usually before November 1. Letters received from fishermen during the latter part of October, however, indicated that large numbers of spawning fish had made their appearance, and it is possible that many eggs can be secured there in the future during the closing days of that month. The eggs were packed in cases and forwarded from the field stations direct to Northville by freight, as usual, one of the employees meeting the boat on its arrival at Detroit. Shipments of eyed eggs, aggregating 4,535,000, were made between October 9 and December 28 to other stations of the Commission, State fish commissions, and foreign applicants, 1,500,000 of this number being sent to the Alpena hatchery. The eggs commenced hatching early in December, and on January 1 a carload of fry was deposited in the Straits of Mackinac. No other shipments were made until February, when 3,492,000 were disposed of. A few of these were given to private applicants and the remainder deposited at various points in the Great Lakes, on the natural spawning-grounds.

It was intended to carry the balance of the fry (250,000) until fall, but the tanks became so overcrowded in May that it became necessary to distribute 50,000 of them. These had made a remarkable growth during the three months they were retained in the troughs, and when planted they were 3 inches in length. At the close of the year there remained on hand 160,244 fingerlings, the average weight of which was $4\frac{7}{8}$ pounds per 1,000.

As the stock of brood-fish of the brook trout at the station was very small, arrangements were made with the Michigan Fish Commission to make collections on the Au Sable River. A field station was opened on that stream late in September, and under the direction of Mr. A. T. Stewart 10,000 fish were captured, chiefly by means of seines, hook and line being used only where they were scattered. They were confined in two ponds, and during the fall 516,400 eggs were obtained from them and transferred to Northville, the shipments being so arranged as not to hold the eggs longer than the eighth day, as experiments in 1895 demonstrated that they could be moved with safety up to that time. The eggs collected at this point were not so good as those taken from the brood-fish at Northville, and cost about $1 per 1,000 delivered at the station.

From the two-year-old brood-fish 128,350 eggs were obtained, 304 females yielding an average of 422 each. The fry commenced hatching early in December, and on February 3 a shipment of 100,000 was sent to the Au Sable. Various other plants were made from time to time until March 23, the total distribution aggregating 228,000. At the close of the year there remained on hand 15,000 fingerlings, their average weight being $6\frac{1}{2}$ pounds per 1,000.

The Loch Leven trout commenced spawning October 15, and from that time until the 27th of November 74,525 eggs were collected from 75 females. The eggs were of poor quality, due, it is thought, to the advanced age of the fish. Shipments aggregating 25,000 were made to private applicants; the balance were hatched, and at the close of the year there were 4,715, of an average weight of $2\frac{3}{16}$ pounds per 1,000. There are also 2,969 two-year-old fish in stock, which will spawn during the coming season.

The steelhead fingerlings on hand at the commencement of the year were retained at the station until March, 1898, when 3,500 were planted in the Pere Marquette River and Cold Creek, and 200 of them were transferred to the Omaha Exposition. It is intended to rear the balance for breeders, as an experiment. These fish did not attain as great a growth as the rainbow, Loch Leven, or brook trout raised under the same conditions, but reports from various sections in which plants have been made indicate the capture of quite a number of specimens measuring from 10 to 12 inches, especially in the Pere Marquette River. None of these specimens have so far been identified, however. On April 19 a shipment of 95,880 eggs was received from Fort Gaston, Cal. These were hatched, and the 75,000 fry resulting from them were planted during the month of May in Little Manistee River, Manistee County, near Grand Rapids, Mich., and various streams tributary to Lakes Huron and Michigan.

A few breeding black bass transferred to this station two years ago are still in stock. They spawned early in June, but as there were no suitable ponds for the reception of the fry, no efforts were made to rear them.

DULUTH HATCHERY.

The following table shows the number of fish on hand at the close of the year:

Species.	Calendar year in which fish were hatched.				
	1898.	1897.	1896.	1895.	1894 or before.
Brook trout	15,600	1,412	1,200	.....	.....
Loch Leven trout	4,715	2,967	.....	293	16
Lake trout	160,244	.....	.....	.....	.....
Steelhead trout	7,000	910	.....	.....	.....
Rainbow trout	.....	800	.....	.....	.....
Black bass	.....	124	80	.....	.....
Total	187,559	6,213	1,280	293	16

ALPENA STATION, MICHIGAN (FRANK N. CLARK, SUPERINTENDENT).

In addition to a number of minor repairs made during the summer, a new floor was laid in the hatchery, the batteries were rebuilt, and new tanks were purchased and installed. This work was directed by Mr. W. W. Thayer, in the absence of Mr. S. W. Downing, the foreman. No special efforts were made to collect whitefish eggs, owing to the passage of a law prohibiting fishing from November 1 to December 15, but 480,000 were obtained from fishermen in the vicinity; 10,000,000 were also transferred from Put-in Bay during the month of December. The fry commenced hatching on April 7 and finished April 16. The entire lot was planted in Lake Huron with the exception of 500,000 deposited in Clear Lake.

Attention is called to the following instance, as indicating to what extent whitefish eggs may increase in bulk after having been placed in the hatching-jars. On November 15 a spawn-taker secured 56 ounces of eggs from one whitefish, as measured 10 hours afterward. They were placed in a jar by themselves and left undisturbed until March 7 except to clean off the dead ones, when they were again measured and found to contain 64 ounces.

In addition to the whitefish hatched at the station 1,500,000 lake-trout eggs were transferred from Northville. These were hatched in February and the fry resulting from them were planted in March at various points on Lakes Huron and Michigan.

Mr. Downing returned to the station on October 26 and remained in charge until the close of the year, when the hatchery was dismantled and the hatching apparatus cleaned, painted, and put away for the season.

DULUTH STATION, MINNESOTA (S. P. WIRES, SUPERINTENDENT).

During the summer 240 fry troughs, 7 feet 5 inches long, 11 inches wide, by 7¾ inches deep, were constructed for the lake-trout work; the grounds in front of the hatchery were plowed, partially graded, and the old carp ponds filled in; repairs were made to the supply tank and hatching-room, and the flume leading from Leslie River, which had been damaged by freshet during the past summer, was rebuilt.

The lake-trout season opened the middle of September and closed the 9th of November, 7,007,000 eggs of excellent quality being secured from the following points:

Locality.	Number.	Locality.	Number.
Port Caldwell, Ontario	800,000	Long Point, Isle Royale, Mich	740,000
Port Arthur, Ontario	2,346,000	Grand Portage, Minn	260,000
Little Todds Harbor, Isle Royale, Mich.	460,000	Washington Harbor, Isle Royale, Mich.	800,000
Fishermen's Home, Isle Royale, Mich..	475,000	Ontonagon, Mich	1,000,000
Siscowet Bay, Isle Royale, Mich	126,000		

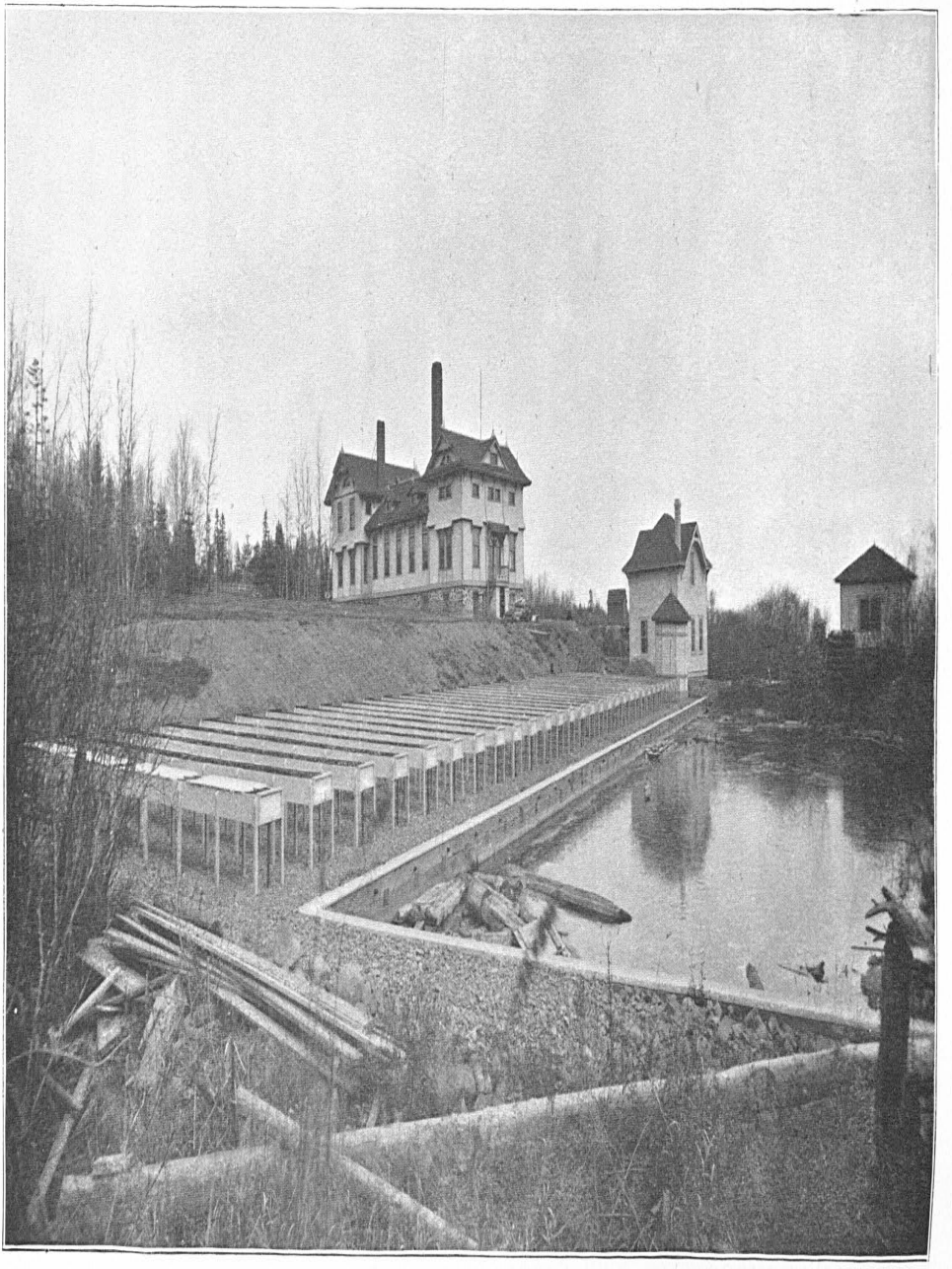
A shipment of 480,000 eyed eggs was transferred to the Manchester Station; the balance were hatched and deposited on the spawning-grounds where the fish were captured, the distribution extending from early in April to June 22. The output amounted to 5,143,000 and the total loss of eggs and fry to 1,384,000.

An effort was made to collect whitefish eggs in the neighborhood of Port Arthur, but only 200,000 could be secured prior to the close of the fishing season on November 1. Spawn-takers were also sent to Basswood and Crooked lakes, Minnesota, but no eggs were obtained. Many fish were captured at these points, but no ripe ones were found, which indicated that the fishing in the vicinity is not on the spawning-grounds. The eggs obtained at Port Arthur were of poor quality and yielded only 98,000 fry; these were planted near Isle Royale.

During January 100,000 brook-trout eggs were received from Leadville, from which 92,550 fry were hatched and planted in the waters of Minnesota and South Dakota. Consignments of steelhead eggs, amounting to 150,000, arrived from Fort Gaston in April. They were of good quality and produced 130,000 fry, which were liberated in suitable streams emptying into Lake Superior.

MANCHESTER STATION, IOWA (R. S. JOHNSON, SUPERINTENDENT).

As soon as the appropriation of $4,216 became available, work on the buildings and grounds was resumed, under the direction of the superintendent. During the summer and fall of 1897 and the spring of 1898 three large stock-ponds were excavated and graded, the ponds being connected with wooden flumes to get a circulation of water from one to the other. Owing to the large amount of sand in the soil, it was afterwards found necessary to line the bottom of one of the ponds with clay; but the results were not satisfactory. Seven large rearing-ponds, 80 by 20 feet, were graded and the sides lined with 2-inch hemlock plank. The bottoms were covered with clay, and on this was spread 4 inches of muck. They were arranged in tiers, so that the water could pass from the upper ones into the lower. Twenty-four small rearing-ponds, 7 by 22 feet, were constructed in a similar manner, and twelve existing ponds of the same kind, previously lined with stone, were remodeled and wood lining substituted. Connections were also made from the lower reservoir for supplying the large and small rearing-ponds. In order to avoid a recurrence of damage from freshets,



DULUTH HATCHERY, NURSERY TROUGHS, AND STOREHOUSE.

the wagon-bridge was raised 1½ feet and extended 20 feet, a new stone abutment being built on the west side of the branch; the roadway was raised to the same height and a dry stone wall built along the road to prevent washouts.

For the protection of the 14-inch water-supply pipe and ponds a dry stone wall was also built along the spring branch. All of the grounds around the buildings and ponds were graded and terraced, and roadways were built from the main entrance to all the buildings and ponds. These roadways were graded and bedded with gravel, and surface gutters of stone were provided. The necessary fences were also erected alongside the country road from the Fish Commission reservation to the main highway, and all of the lands were sown with blue grass and white clover. An hydraulic ram, for forcing water to the dwelling, mess-house, and barn, was placed in the hatchery. All of the dead timber on the reservation was cleared up and converted into stove wood. An orchard, consisting of assorted apple, cherry, plum, and pear trees, blackberry, raspberry, currant, and gooseberry bushes, strawberry plants, and grapevines, was set out south of the dwelling-house.

As soon as the ponds had been completed, in the latter part of October, arrangements were made to collect brood-fish from open waters in the State. Supplies of large-mouth and small-mouth black bass, rock bass, crappie, and rainbow trout were obtained from the rivers in the eastern part of Iowa. All of the breeding-ponds were planted with *Ceratophyllum*, *Elodea*, *Ranunculus*, water lily, and other aquatic plants, and artificial nests and piles of gravel were located at suitable points in the three large stock ponds and in the 80-foot rearing-ponds. The spawning-beds were partitioned off with inch-mesh wire netting, so that the young fish, by passing out into the main ponds, might escape the depredations of the adults.

The small-mouth bass placed in Pond Z began nesting on the gravel beds on May 2, and a number of nests were observed between that time and June 1. The first fry appeared on May 24, and though quite a large number of nests were seen the indications are that the crop will be small, owing to the difficulty of keeping the ponds full of water and to the absence of the natural food necessary for very young fry.

The large-mouth black bass collected from the Maquoketa River and in the vicinity of Quincy, Ill., suffered severe losses during the winter, owing to injuries received in transportation. In the spring 180 remained on hand, which were placed in Ponds X and Y. The majority of these fish spawned on mud bottoms, only a few of them using the gravel, and in no instance were the artificial nests occupied. The first eggs were noted on May 11, but no fry were observed until June 1. At the close of the spawning season the adult fish were removed from the breeding-ponds, so as to give full range to the fry. No effort was made to determine the exact number on hand at the close of the year, but it is believed that the results will be good, notwithstanding the fact that owing to the very scanty growth of aquatic vegetation natural food is not as

abundant as it should be. The maximum temperature of the water in these ponds between April 1 and June 1 was 78°; minimum, 48°.

In the spring the 180 adult crappie remaining were placed in three of the 80-foot ponds. They were observed nesting on May 11, and though a number of nests were noticed between that time and June 4 no young fish were discovered.

A supply of rock bass was also placed in one of the 80-foot ponds. They commenced to spawn about the middle of May, and at the close of the year several schools of young fish were seen in this pond.

In addition to the rainbow trout on hand at the beginning of the year, 1,000 yearlings were received from Neosho in November. These arrived in excellent condition and were placed in the ponds with the others to be reared. In January and February two consignments of eggs, amounting to 44,720, were received from Neosho, which produced 30,364 fry. Of these, 4,000 were distributed to applicants in Iowa and 26,363 remained on hand at the close of the year. During the fall 85 2-year-olds and 74 yearling rainbow trout were collected from one of the streams in the vicinity of the station and added to the brood stock.

All of the brook-trout streams in the eastern and northern parts of the State were examined during the summer, with a view to making collections of eggs and brood-fish, but at no point could sufficient numbers be found to justify the expense of establishing a field station for the collection of eggs. 513 adult trout were secured, which yielded 38,592 eggs during October. In addition to these, 100,000 brook-trout eggs were purchased in Massachusetts, which arrived in excellent condition in January and produced 83,700 fry. During the spring 19,000 brook-trout fry were distributed, and at the close of the year there remained at the station 79,595 fry. Consignments of 480,000 lake-trout eggs from Duluth and 50,000 grayling from Bozeman were transferred to this station. The lake trout arrived with a loss of only 723; subsequent losses, amounting to 42,600, occurred, however, during incubation.

The fry which resulted from these eggs, amounting to 437,000, were planted in public waters during the spring, with the exception of 400 which were held for experimental purposes. The grayling eggs, which arrived in fair condition, hatched in June with a loss of 8,710. They appeared to be strong and healthy, though it is difficult to induce them to take artificial food.

The stock on hand at the close of the year was as follows:

Species.	Calendar year in which hatched.			
	1898.	1897.	1895.	1894.
Brook trout	79,595	.....	288	198
Rainbow trout	26,365	3,396	.....	.....
Lake trout	400	.....	.....	.....
Grayling	50,000	.....	.....	.....
Loch Leven trout	.....	.....	41	.....
Large-mouth black bass	.....	.....	.....	175
Small-mouth black bass	.....	.....	.....	38
Rock bass	.....	.....	.....	24
Crappie	.....	.....	.....	179

BASS PONDS AT MANCHESTER, IOWA.

It is believed that large numbers of young black bass and crappie could be collected from the overflowed lands along the Mississippi River in the vicinity of Bellevue, Iowa, and it is recommended that investigations be made with the view to establishing a collecting station at that point.

QUINCY STATION, ILLINOIS (S. P. BARTLETT, SUPERINTENDENT).

The spring of 1897 opened with cold rains, which continued at frequent intervals until July, and apparently affected the spawning of black bass in the vicinity of Meredosia, as very few fry were observed. Great difficulty was consequently experienced in making the usual collections; even at the commencement of operations the fish captured from the overflowed ponds and lakes measured from 5 to 7 inches in length, showing they had hatched the previous year. As the season advanced the weather became extremely hot and dry, and continued so until late in October, making it difficult to transfer fish from the ponds to the station.

As a result of the operations for the season 25,139 black bass and 3,468 crappie were delivered to the cars for distribution.

The weather conditions during the spring of 1898 were much more favorable, the rivers being high early in the spring and remaining in that condition long enough for the bass and other fish to deposit their eggs in the interior lakes and sloughs. While engaged in collecting two carloads of fishes in Meredosia Bay in May and June for the Omaha exposition, large numbers of young bass were observed, and 5,000 were easily caught and transferred to the ponds at the station.

The property at Meredosia is in good condition. The buildings were painted during the year, the grounds seeded, and other steps taken to improve the appearance of the station.

NEOSHO STATION, MISSOURI (H. D. DEAN, SUPERINTENDENT).

At the beginning of the year 90,725 rainbow-trout fry were on hand, but losses occurred during the summer and fall, which reduced the number for distribution in October to 75,850. Of these, 72,850 were deposited in public and private waters, 2,000 were retained for brood stock, and 1,000 were transferred to Manchester Station. The brood stock on hand consisted of 1,580 three-year-olds, 311 four-year-olds, and 209 from five to ten years old. From 321 ripe females three years of age a total of 188,320 eggs was secured, an average of 586 each; 154 of the old fish produced a total of 216,815, an average of 1,400 per fish. Of the former, only 43 per cent were good; of the latter 58 per cent.

The first eggs were secured in December, and collections continued from that time until March 1, the total take amounting to 405,435. Of these, 207,814, or 51 per cent, were eyed. At the close of the year there remained on hand 92,200 fry, 14,000 having been distributed in April and May.

The poor quality of the eggs may be attributed to some extent to the fact that the fish were kept during the spawning season in ponds with-

out raceways; consequently it was necessary to handle them daily in order to select the ripe ones.

Of the 11,326 black bass on hand in July, 10,151 were distributed during the fall. The distribution was very successfully accomplished, the loss amounting to almost nothing. During the summer it was noticed that one trough of fish in the hatchery were not doing well. They were transferred to another trough in the spring branch which was supplied with warm water, and in a few days they were thriving. In October 100 of the adult bass collected from Meredosia Bay were transferred to the station. They were placed in the ponds, and were taught in a few days to take artificial food: At first fish cut in large pieces was fed to them along with minnows; after a short time the minnows were omitted, liver being mixed with the cut fish, and a few days later they were taking liver and beef without trouble. When the pond was drawn in March, 98 of this lot remained.

Owing to the roily condition of the water during the spring, spawning was observed in only one instance. Large numbers of fry were seen in the ponds later, but no attempt was made to transfer them, as the water contained an abundance of natural food. Contrary to the usual practice, the ponds were kept full of water during the winter, and at the spawning time they were abundantly supplied with vegetation and insect life. A few young fish were transferred to the hatchery for experimental feeding, and no difficulty was experienced in teaching those over half an inch in length to take food.

When the distribution of rock bass was made in the fall, 13,618 fish remained of the 14,850 on hand in July. In the spring, when the pond was drawn to prepare it for the breeders, 1,950 young bass were taken out which must have hatched there late in the fall. Spawning occurred at the usual time and numbers of young fry appeared later.

The results of last season's work with strawberry bass and crappie, though not so large as had been hoped for, were the most successful so far attained at the station. Of the 10,630 fry on hand from the hatch of the previous spring, 56 per cent, or 5,962, were distributed in the fall. It is very difficult to handle these fish in warm weather, and it is also hard to teach them to take food. In the spring 62 strawberry bass were placed in pond 14 and 11 crappie in another pond.

The following table shows the number of fish on hand at the close of the year, and the maximum, minimum, and mean temperatures to which the various species were subjected:

Species.	Calendar year in which hatched.			Temperature to which subjected.		
	1898.	1897.	1895.	Max.	Min.	Mean.
				°F.	°F.	°F.
Rainbow	92,200	1,074	1,200	75	46	58.34
Black bass	.....	95	198	91	32	60.79
Rock bass	.....	1,950	92	80	36	58.25
Crappie	.....	.....	11	87	32	59.10
Strawberry bass	.....	71	60	90	33	58.22

The following table shows the air and water temperatures and the amounts of rain and snow as recorded by months:

Month.	Max.	Min.	Mean.	Precipitation.	Snow.	Month.	Max.	Min.	Mean.	Precipitation.	Snow.
1897.				*Inches.*	*Inches.*	1898.				*Inches.*	*Inches.*
July	95	49	77.75	1.85	.....	January	70	14	39.47	3.44	.....
August	96.5	49	74.28	.74	.....	February	68	6	41.23	.47	.31
September	96.5	34	73.10	.....	.....	March	76	16	47.90	7.40	1
October	91	28	63.71	.60	.....	April	84	23	54.60	2.97	.....
November	75	14	48.55	1.78	.....	May	88	38	67.10	10.43	.....
December	70	12	34.66	2.71	3	June	91	59	75.70	4.73	.....

During the summer many needed repairs and improvements were made in the hatchery and annex, including the construction of lockers in the carpenter shop for the storage of tools and as receptacles for fish food. It was found necessary to reline many of the ponds, nothing having been done to them since they were constructed in 1889. The material used was 1½-inch matched pine dipped in boiling tar. New standpipes of the same material were constructed where needed, an additional 6-inch supply pipe was laid from the spring to the hatchery, and a pool 5 feet by 40 feet was built at the head of pond 5. Two new plank pools were also built—one at the head of No. 5 for storage and the other between Nos. 15 and 16—and a small egg-shaped pond was constructed at the head of No. 16.

San Marcos Station, Texas (J. L. Leary, Superintendent).

In July the employees of the station resumed the distribution of fish to applicants in the State, and disposed of 14,500 black bass and 3,700 rock bass. The distribution was again taken up April 25, 1898, and continued until June 3, during which period 17,100 black bass were handled, making a total distribution during the year of 31,600 black bass, 3,700 rock bass, and 50 crappie.

In making these plants the employees traveled 15,549 miles, 11,549 of which were free. The distribution was very successfully accomplished, but few fish being lost.

During the winter collections were made from the San Marcos and Blanco rivers to increase the stock of brood-fish. The bass commenced nesting on February 10 and were still spawning at the close of the fiscal year. Most of the eggs were deposited on clay bottom, though a few of the fish used the piles of gravel which had been placed in the pond. The fry commenced to hatch in February, and by April many were 2½ inches long. Their food was similar to that used during the past year, consisting largely of young mud shad, minnows, salted fish roe, and such natural food as the ponds contained.

The crappie and rock bass commenced nesting during the latter part of March and many of them had not finished spawning at the close of the year. Young rock bass about an inch in length appeared in large numbers in the ponds, but no crappie have been seen. Once or twice

during the season the crappie seemed to suffer from an affection of the eyes. This was attributed to the clear, shallow water, and was partly overcome by partitioning off a part of the pond and placing in this space a lot of carp, which stirred up the mud and kept the water cloudy.

In order to increase the food supply at the station a pond, 1½ acres in area, was constructed during the summer, so arranged as to have a very large area of shallow water; it was nearly oval in shape, and varied in depth from nothing to 9 feet at the stand-pipe. It was supplied with water by means of a hydraulic ram placed at the lower end of the grounds near the river and operated by the overflow of the upper ponds, the fall being 3¾ feet. By this means an average of 50,000 gallons of water per day enters the pond, and so far it has been kept full constantly, though the weather was very dry for six months of the time and the evaporation and absorption great. The ram has been running steadily since October 7, and has required very little attention except to keep the screen clean. This pond has proved a great success, both for the production of food and for rearing bass. The large area of shallow water provides a great quantity of insect life and a safe retreat for young fish. When sudden changes of temperature occur, the fish seek the deep water.

The construction of four additional ponds was commenced during the spring near the southwest end of the grounds; each of them will be ¼ acre in area and similar in character to the one built during the previous summer. A water-wheel was also built on the river to supply water to this new system. The water will be pumped into a distributing reservoir and conducted from there to the ponds by gravity. The grounds have been improved by planting Bermuda grass and shade trees, and a small orchard of pear, apple, plum, and other fruit trees was set out in the fall. These are doing well, only four having died during the year.

At the close of the year the stock on hand was as follows:

Species.	Calendar year in which hatched.			
	1897.	1896.	1894.	1893.
Black bass	9,000	50	67	99
Rock bass	.....	.....	200	.....
Crappie	52	.....	100	100
Mud shad	.....	.....	200	.....

LEADVILLE STATION, COLORADO (E. A. TULIAN, SUPERINTENDENT).

The usual arrangements were made with the owners of Wellington, Decker, Oneva, and Musgrove lakes, and Gale, Smith, and Ridgway ponds for collecting brook-trout eggs, the owners to receive half of those obtained. Early in October the first eggs were secured from the stock-fish at the station, and from that time to the close of the season, or until work was stopped by ice, operations were actively pushed at all the points mentioned.

The results are shown in the following table:

Source.	Eggs collected.	Eggs lost.	Brook-trout fry hatched.
Station brood-fish	*428,000	108,920	22,080
Uneva Lake	256,780	8,830	247,950
Gale's fish	109,000	7,060	109,940
Smith's fish	262,900	10,650	252,250
Ridgway's fish	202,400	82,400	120,000
Wellington Lake	854,100	137,130	716,970
Young's fish	88,100	34,520	53,580
Decker's fish	96,900	53,140	43,760
Musgrove's fish	801,520	349,870	451,650
Total	3,100,300	793,120	2,010,180

*297,000 eggs of this lot shipped from station.

The total collection exceeded that of the previous year by nearly 1,000,000. The superintendent and foremen performed all the work of taking and fertilizing the eggs, and, except those from Musgrove and Decker lakes, they were of excellent quality, considering the conditions under which they were taken. The large loss on those from Musgrove Lake was undoubtedly due to the necessity of crowding the fish into a very small pond and holding them there for several weeks to ripen. The poorest eggs were obtained from fish that had been held a considerable time before spawning. All of the eggs were transferred to the Leadville Station to be hatched, and during the spring 581,000 of the fry were distributed in public waters and supplied to applicants in Colorado and Utah; 930,900 were turned over to the owners of the various lakes from which collections were made, and 340,000 were held for distribution in the fall. Shipments of the eyed eggs, aggregating 172,000, were made in January and February to private hatcheries in Utah, Montana, Washington, and California, and 150,000 were transferred to other stations of the Commission. The capacity of the hatchery was severely tested by the large collections, and in April it was found necessary to erect a number of temporary troughs. The fingerlings on hand at the beginning of the year (241,465) were carried in troughs and ponds until September, with a loss of 69,365, when they were distributed in public waters in the Northwestern States.

Of the Loch Leven trout fry on hand in July, 8,000 were distributed in October, leaving 2,000 on hand January 1; these will be held for brood stock. There were also 4,170 two-year olds on hand in July, but severe losses during the summer reduced the number to 1,870 at the close of the year. The brood-fish commenced spawning October 14, and during the fall produced 53,100 eggs, which hatched with a loss of 9,720, or about 18 per cent. When the eye-spots developed 15,000 of the eggs were shipped, and at the close of the year there were 25,100 fry.

On September 1 the 21,695 fry remaining from rainbow-trout eggs hatched during the summer were distributed with little loss. In April 26,800 eggs were collected from Loveland Lake, but the majority of them were lost in incubation. This was undoubtedly because the fish were held in a small crate for some time before they were ready to

spawn; they weighed from 5 to 8 pounds, and many of them became badly bruised. Arrangements have been made to construct a large pond for this purpose in future. There are a large number of fish in the lake, and as they are apparently in good condition, there is no doubt that it will prove a good field for collecting eggs of this species.

The brood-fish at the station yielded 15,300 eggs in May, 9,000 of which were shipped in June.

No effort was made to collect eggs at Uneva, as ice remained on the lake much later than usual, and when it finally disappeared it was found that the majority of the fish had spawned.

No collections of yellow-fin trout eggs were made this season, and all of the fry on hand at the beginning of the year were planted during the fall. There were also at the station 289,600 black-spotted trout eggs and 164,680 fry. Of these, 124,900 fry and 29,500 eggs were the result of collections made at Freeman Lake. In the fall 270,000 of the 273,000 fingerlings available for distribution were planted in the waters of Colorado, Idaho, Montana, Washington, South Dakota, and Nebraska. The remainder were placed in one of the small ponds at the station, but all except 400 escaped into Rock Creek.

On account of the uncertain results attending the work at Twin Lakes during the past five or six years, and the expense connected therewith, it has been determined to discontinue operations at that point. The usual collections were made at Freeman Lake in June, 158,800 eggs being obtained. These were transferred with little loss to the Leadville Station and were in the troughs on June 30.

The stock of fish and eggs on hand at the close of the year is shown by the following table:

Species.	Calendar year in which fish were hatched.				
	1898.		1897.	1896.	1894.
	Eggs.	Fry.			
Brook trout	.....	340,000	.....	.....	195
Loch Leven trout	.....	25,100	1,700	2,300	40
Black-spotted trout	153,600	.....	430	.....	.....
Rainbow trout	4,900	3,000	.....	.....	.....
Grayling	.....	41,500	.....	.....	.....

During the summer many repairs and improvements were made: The superintendent's cottage was painted and the 2-story frame-house occupied by the station employees was painted, shingled, and weather-boarded. The kitchen and mess-house were repainted and repapered and new floors laid; material was gotten out for the building of a log stable near the mess-house, and posts were set preparatory to fencing in a piece of land for pasture. A 6-inch galvanized-iron pipe, 140 feet long, for drawing water from the upper Evergreen Lake, was placed in position in August, and the stumps and rubbish on the seining-grounds were removed. All of the adult trout were removed from the middle lake, which was set aside as a nursery for yearling brook and rainbow trout.

BOZEMAN STATION, MONTANA (JAMES A. HENSHALL, SUPERINTENDENT).

For the purpose of increasing the water supply during the summer, a ditch 1,500 feet long, with the necessary head-gates, etc., was constructed from a point in Bridger Creek, in the canyon, to a large supply and settling pond located southwest of the hatchery at the head of the large rearing-ponds, in order that the water might be used during the summer and fall. This pond will also be supplied with water from warm springs on the opposite side of the creek, which has a regular temperature of 77° throughout the year.

The brook-trout and steelhead fry on hand at the beginning of the year were distributed in August in suitable streams and lakes throughout the State, except 3,000 brook and 10,000 steelheads reserved for brood stock.

It having been decided not to attempt the collection of eggs at Soda Butte Lake, Yellowstone Park, and Mystic Lake, which had been examined during the previous spring, arrangements were made to establish auxiliary stations for the collection of black-spotted trout and grayling eggs in the Upper Madison River, Montana, and at Henry Lake, across the Continental Divide, in Idaho. An investigation of the streams in the vicinity of Deer Lodge, in the Big Blackfoot Valley, was also made, and an abundance of trout was found.

Early in March the equipment for the auxiliary stations, consisting of 14 hatching-troughs, 600 trays, 300 screens, and 24 egg-cases, which had been constructed by the employees of the station, was sent to Monida by rail, thence by sleighs and dog-sleds to the points selected. Operations were commenced at Henry Lake under the direction of Fish-culturist Jarvis. A temporary hatchery was established in a log cabin 15 by 15 feet, equipped with 6 hatching-troughs 8 feet long, the water supply being taken from a spring pond in the vicinity with a temperature of from 42° to 50°. About 6,000 trout were collected and placed in the ponds during the early spring, but only 186,000 eggs were obtained. Of these, 11,000 were lost in incubation, 20,000 were hatched and planted in a tributary of the lake, and the balance (155,000) were transferred to Bozeman.

The spawning season opened on April 6 and continued until May 30, though the greater part of the eggs were taken between April 15 and May 15.

Operations at Horse-thief Springs were undertaken at the same time under direction of Mr. A. J. Sprague, but early in April this site was abandoned and the equipment transferred to Red Rock, Mont., 40 miles nearer Monida and 20 miles west of Henry Lake. These stations are on opposite sides of the Continental Divide, Henry Lake being on the headwaters of the Snake River and Red Rock at the head of the Jefferson River. The equipment here consisted of 6 hatching-troughs 8 feet long, with the ordinary trays of woven wire, mesh $\frac{1}{3}$ inch by $\frac{1}{2}$ inch. The water supply was from a spring about 75 yards distant, of a temperature varying from 46° to 55°. As there was no building in the

vicinity that could be used, an awning of canvas was erected over the troughs.

The work was successful, over 3,000,000 grayling eggs being collected between May 7 and June 20. Of these, 1,500,000 were hatched at the substation and deposited in Elk Creek, an inlet of Red Rock Lake. Of the balance, 1,000,000 were transferred to Bozeman and 110,000 were shipped to other stations.

The eggs of the grayling are much smaller than those of the trout and measure one-seventh of an inch in diameter after fertilization. They are very light-colored, almost crystal-clear, and are slightly adhesive after fertilization, forming bunches and quickly developing fungus. Their specific gravity was found to be less than that of trout eggs, and from the experience gained it appears that they might be hatched or at least eyed under pressure of water, by methods similar to those employed in hatching eggs of the shad and whitefish, rather than on trays. The embryo began to show life and movement before the appearance of the eye-spot, which occurs in from 3 to 5 days. They hatch in from 10 to 12 days at a temperature of 50°. The fry are quite small, about half an inch long, and after the absorption of the yolk-sac, which requires about a week, they rise to the surface and swim freely. Considerable difficulty was experienced in providing acceptable food for them, and the loss before they commenced feeding was estimated at 50 per cent. Those hatched at the substation and planted in the creek from which the eggs were taken seemed to grow much faster than those in the hatchery.

Notwithstanding the short period of incubation, little difficulty was experienced in the transportation of eyed eggs. The consignments sent to Manchester, Leadville, and Omaha arrived in good condition. They were packed in the manner usual with trout eggs, except that no moss was placed between the trays, as the least pressure on the eggs kills the embryo. Most of the loss in shipments to Bozeman was caused by the scarcity of ice at the auxiliary station. One shipment of green eggs was made, but all of them died eventually, though they were apparently in good condition on arrival.

During the spring 100,000 brook-trout eggs and 50,000 steelhead eggs were received from the Leadville and Fort Gaston stations, and from a private hatchery at Hudson, Wis. These were hatched as usual and held at the station until the close of the year, when there remained on hand the following stock of fish:

Species.	Calendar year in which fish were hatched.	
	1898.	1897.
Grayling	500,000	.....
Black-spotted trout	150,000	250
Brook trout	55,000	2,800
Steelheads	32,000	9,700

BAIRD STATION, CALIFORNIA (G. H. LAMBSON, SUPERINTENDENT).

On July 10 Mr. Livingston Stone, who had been in charge of Baird Station almost continually since its establishment, was transferred to Cape Vincent, N. Y., and Mr. G. H. Lambson was appointed superintendent. In addition to his duties at Baird the superintendent was detailed to assist Mr. J. P. Babcock, of the California Fish Commission, in the management of the Battle Creek Station, having charge of all the accounts of the latter station.

In order that the station might be in readiness for eggs from the first run of salmon, the fishing apparatus was overhauled and repaired in July, the filtering-tanks, corrals, seining-reel, and whim rebuilt, and log-cabins erected for the use of the seining crew. When fishing commenced, on August 14, a great many salmon were noticed below the rack which had been placed across the McCloud River at the beginning of the year. At the first haul 15 ripe females were captured. Fishing continued without interruption until September 20, when the first run was over. During this period 6,327 females were handled, of which 1,555 were ripe, yielding 7,000,000 eggs, an average of 4,501 per fish.

The second run commenced in October (the first haul of the seine being made on the 7th) and continued at intervals until December 8, 2,065 females being captured, of which 506 were ripe. From this run 2,194,000 eggs were collected, a total of 9,194,400 for the season.

The following table shows the daily catch of fish, ripe females, and eggs collected, with mean temperatures of water on fishing-grounds:

Date.	Fish taken.		No. of females stripped	No. of eggs taken.	Mean temperature.	Date.	Fish taken.		No. of females stripped	No. of eggs taken.	Mean temperature.
	Males.	Fem.			°		Males.	Fem.			°
1897.						1897.					
Aug. 15	520	351	21	101,120	56.0	Oct. 28	67	49	1	2,000	46.7
17	532	311	20	97,600	56.0	29	59	60	3	14,000	45.7
20	425	342	28	132,800	56.0	30	53	32	1	3,000	45.7
22	518	480	59	205,600	57.0	31	71	43	4	15,000	46.3
23	329	216	24	107,200	56.5	Nov. 2	63	25	2	6,400	46.0
24	543	462	50	221,680	56.0	3	80	67	16	65,600	45.0
25	410	240	36	169,600	55.4	4	51	39	4	17,000	45.0
26	390	216	30	142,000	55.0	5	19	22	4	15,000	45.0
27	651	402	61	268,400	55.0	6	40	28	4	16,000	43.7
28	663	405	62	273,000	54.3	7	76	41	3	14,400	43.3
29	306	288	35	163,000	53.6	8	21	15	2	7,500	42.7
30	337	357	62	278,000	52.7	9	29	18	2	9,000	42.7
31	369	374	76	350,000	52.7	10	22	27	3	14,000	44.7
Sept. 1	209	261	91	413,000	52.8	11	64	41	6	27,600	46.3
2	216	197	83	369,000	54.0	12	153	89	36	155,600	45.7
3	204	201	96	426,000	53.7	13	59	48	10	45,000	45.0
4	197	204	114	504,000	54.0	14	25	16	2	8,000	43.7
5	119	161	91	411,000	53.0	15	27	19	3	11,200	41.3
6	194	203	119	529,000	54.0	17	43	27	5	19,600	42.0
7	126	128	73	329,000	53.6	18	28	33	6	25,000	43.3
8	99	112	66	291,000	52.6	19	80	116	80	359,000	43.2
9	68	47	28	126,000	51.6	20	131	120	39	177,800	43.5
10	73	62	38	168,000	51.3	21	195	217	51	222,000	45.5
11	57	66	40	184,000	51.0	22	41	27	16	70,400	44.7
12	40	44	26	120,000	51.6	23	36	30	12	54,400	43.3
13	38	57	34	152,000	51.6	24	54	67	22	96,800	44.3
14	33	52	31	135,000	52.0	25	14	8	5	24,500	43.7
15	17	39	27	124,000	52.2	29	32	22	6	25,000	43.0
16	12	27	19	84,000	52.3	30	41	39	8	34,000	44.7
18	7	16	12	53,000	53.2	Dec. 1	93	91	37	160,000	44.7
20	4	6	3	12,000	52.6	2	38	33	0	24,000	41.7
Oct. 8	62	40	1	3,000	51.7	3	11	8	2	6,000	40.7
15	83	48	1	2,000	47.7	4	24	15	3	10,400	40.7
20	67	45	1	5,000	47.3	6	21	16	8	33,000	43.0
21	54	67	2	5,000	47.3	7	99	95	76	325,000	44.0
22	70	44	1	4,000	46.3	8	15	12	5	23,000	43.7
23	142	78	4	18,000	46.7						
24	77	46	2	7,600	45.7	Total.	10,315	8,392	2,061	9,194,400	
26	79	42	1	3,000	46.0						

Of the eggs collected at Baird, 6,255,000 were transferred to the California State Fish Commission hatchery at Sisson, Cal., 250,000 were shipped to France, Germany, Italy, and Japan, and 20,000 were sent to the Tennessee Centennial Exposition at Nashville, Tenn. The remaining eggs, together with 4,247,000 transferred from Battle Creek, were hatched and planted in McCloud River with a loss of 354,600 during incubation.

The eggs and milt were taken simultaneously in a dry pan and at once stirred with a feather until the milt was completely mixed with the eggs, when a small quantity of water was added and the eggs again stirred, after which the pan was filled with water and allowed to stand until the eggs separated. As soon as they were washed they were carried to the hatchery and placed in baskets, 30,000 to the basket. The dead ones were kept picked off until the critical stage arrived—that is, the time of the formation of the spinal column, which requires from 4 to 8 days, according to the temperature of the water. During this period the covers were kept on the troughs, and the eggs were not touched until the young fish could be plainly seen, after which the picking was continued until they were either shipped or hatched. When the covers are first removed from the troughs the eggs are very dirty, being covered ¼ inch deep with sediment and some little fungus. The loss is small, however, as the under part of the egg, kept clean by the action of the water, is plentifully supplied with air. Some fungus appears in all baskets at this station, though the losses from this source are never large. The picking of the eggs is done by Indian women, some of whom become very expert. In packing eggs for local and foreign shipments the same method was followed as heretofore.

In December a heavy rain set in, which lasted several days, and the river became so high that the racks and wheels had to be removed, which left the station dependent for its supply of water upon the ditch conveying water from Wiley Creek. At the end of two weeks this supply failed and it became necessary to resort to the steam pump for water for the hatchery.

As the number of fish hatched at this station was larger than ever before, it became necessary, owing to lack of trough-room, to plant a majority of the fry before the sac was sufficiently absorbed to permit of their swimming freely in the water. Those planted immediately after hatching collected in large banks or schools in the shallow water away from the swift currents, making no effort to hide or burrow under the stones, and were observed always heading upstream. It is feared that large numbers of them were destroyed by fish; one trout captured at the time was found to have 43 young salmon in its stomach. Those liberated with the sac nearly absorbed disappeared at once under the gravel and stones and remained there until the sac was completely absorbed, when they were observed to go out in search of food in small schools. They then gradually worked their way out into deeper and swifter water until they disappeared. Half a million were held in the

troughs until they were ready to take food, when they were liberated and immediately sought deep and swift water. Six months later numbers were caught with the fly, like trout. In June, 1898, young salmon of two sizes appeared in the river in large numbers, one about 1½ inches long and the other from 3 to 4 inches. The first were supposed to be the result of the last plants and the larger ones of the plant of 1896, though this is only surmise.

In hauling the seine for salmon many large rainbow trout were taken, one weighing 10 pounds and a number from 5 to 7 pounds. These were all returned to the water. Several Dolly Varden trout were also captured. A number of Von Behr trout, the result of a plant of 1,500 of this species in the Upper McCloud River from the Sisson hatchery, were caught with a fly and returned to the water.

During the spring an orchard, covering about 2½ acres, and consisting of apples, pears, peaches, etc., was set out and repairs made to the foreman's cottage and the building occupied as post-office.

The following table gives the maximum, minimum, and mean temperatures of air and water at the station for the fiscal year:

Month.	Maximum.		Minimum.		Mean.		Month.	Maximum.		Minimum.		Mean.	
	Air.	Water.	Air.	Water.	Air.	Water.		Air.	Water.	Air.	Water.	Air.	Water.
1897.							1898.						
July	97	59	73	56	85	57.5	January ..	56	43	35	38	45.5	40.5
August	100	58	72	54	86	56	February .	60	53	39	40	49.5	46.5
September .	97	56	59	50	78	53	March	69	59	43	45	56	52
October	84	53	46	46	65	49.5	April	86	56	49	48	67.5	52
November..	70	47	42	41	56	44	May	90	56	52	48	71	52
December ..	65	45	41	39	53	42	June	92	61	60	50	76	55.5

BATTLE CREEK STATION, CALIFORNIA (J. P. BABCOCK IN CHARGE).

During the summer the ditch used for conducting water from Battle Creek to the hatchery was repaired, the buildings put in order, and a contract made for the erection of a substantial retaining-rack in Battle Creek on the site of the old temporary one operated in the past. This work was much delayed, and, fearing that the first run of fish would pass up the creek before the rack could be completed, a small weir was placed at a riffle half a mile below, the material of the old 1896 rack being used in its construction. This weir proved of great value and remained in place throughout the season, as there were no heavy rains to raise the creek. Trap weirs were also placed at the mouth of Battle Creek to prevent salmon which entered it from returning to the Sacramento River. The failure to provide for this in past years tended to reduce the catch of fish very materially. The seining-grounds below the riffle rack were cleared of snags and brush and the live-boxes placed in the deep water below the weir.

The force engaged was about the same as that employed the year before, consisting principally of residents in the vicinity. Mr. W. H. Shebley had charge of the spawning and seining crews and Mr. E. W. Hunt directed the work in the hatchery.

Seining commenced October 20 and two crews were kept busy night

and day from November 7 until the middle of December, at which time there were still a few fish left in the creek. Only the ripe females and such males as were necessary to accomplish fertilization were transferred from the seines to the crates, the green fish being returned to the creek. No record was kept of the ripe males used, as they were always in excess of the demand. The females were thrown on the banks to die after the eggs had been expressed from them, but the males were returned to the live-boxes and manipulated each day until exhausted. Such of the dead fish as were fit for food were given to those applying for them, and over 600 wagons received fish during the season, some of them coming from points 100 miles away.

The first eggs were secured October 22, the collections to the close of the season being 48,527,500. The smallest take in one day was 85,000, the largest 2,220,000; the average was 1,250,000 per day. The total number of fish spawned was 8,764. The total loss of eggs in the hatchery was 3,395,000. The salmon handled weighed from 2½ to 40 pounds, but the average weight was about 22 pounds.

The following table shows the daily catch of ripe females, eggs collected, daily loss in the hatchery, and temperature of water:

Date.	Number of fish taken.		Number spawned.	Number of eggs taken.	Daily loss of eggs in hatchery.	Water temp. in hatchery, a. m.	Water temp. in hatchery, p. m.
	6 a. m. to 6 p. m.	6 p. m. to 6 a. m.				°	°
Oct. 20	23	....	....	.....	.....	....	....
21	186	....	.....	.....	.....	....	....
22	60	....	81	455,000	.....	56	55
23	29	....	96	560,000	12,500	53	54
24	86	....	124	805,000	17,500	52	56
25	71	....	89	560,000	17,500	52	56
26	157	....	157	910,000	15,000	52	58
27	193	....	65	385,000	25,000	52	58
28	298	....	191	1,050,000	20,000	53	58
29	239	....	300	1,680,000	40,000	54	58
30	252	....	239	1,400,000	37,500	54	58
31	170	....	252	1,435,000	47,500	53	58
Nov. 1	266	....	170	945,000	30,000	54	58
2	174	....	256	1,520,000	40,000	54	56
3	198	....	182	1,040,000	37,500	52	56
4	170	....	200	1,120,000	27,500	51	54
5	176	....	170	920,000	35,000	50	54
6	159	....	175	1,000,000	35,000	50	52
7	97	95	160	880,000	37,500	48	51
8	106	106	191	1,000,000	27,500	47	50
9	110	139	212	1,120,000	32,500	48	53
10	197	99	247	1,280,000	27,500	50	55
11	259	138	295	1,487,500	37,500	53	56
12	143	162	397	2,137,500	62,500	52	56
13	214	225	297	1,560,000	52,500	52	53
14	67	170	439	2,220,000	52,500	50	53
15	107	140	242	1,170,000	47,500	46	50
16	64	154	250	1,290,000	37,500	48	51
17	72	167	215	1,142,000	67,500	48	50
18	127	110	242	1,317,500	37,500	50	54
19	67	104	234	1,275,000	62,500	50	54
20	24	194	170	892,500	82,500	53	54
21	64	93	213	1,190,000	70,000	50	52
22	116	106	162	935,000	72,500	50	50
23	33	172	221	1,232,500	70,000	50	52
24	105	69	207	1,120,000	62,500	49	51
25	33	40	170	1,040,000	65,000	46	49
26	65	36	78	400,000	57,500	45	49
27	55	47	102	560,000	52,500	46	49
28	50	71	100	600,000	67,500	46	49
29	71	78	121	680,000	65,000	48	50
Nov. 30	136	96	150	880,000	50,000	50	53
Dec. 1	85	55	228	1,360,000	52,500	51	52
2	41	36	143	800,000	57,500	46	50
3	26	20	78	400,000	55,000	44	48
4	44	....	45	240,000	62,500	44	48
5	....	74	.....	.....	67,500	48	49
6	90	30	118	720,000	62,500	50	52
7	58	....	127	760,000	55,000	50	51
8	40	28	58	360,000	65,000	50	51
9	5	....	67	360,000	62,500	48	49
10	....	....	17	85,000	57,500	50	51
11	....	....	.....	.....	67,500	51	51
12	....	....	.....	.....	50,000	50	52
13	41	....	.....	.....	62,500	49	50
14	....	....	41	247,500	70,000	48	50
15	....	....	.....	.....	55,000	47	48
16	....	....	.....	.....	65,000	45	48
17	....	....	.....	.....	70,000	44	47
18	....	....	.....	.....	52,500	45	47
19	....	....	.....	.....	65,000	43	46
20	....	....	.....	.....	60,000	43	46
21	....	....	.....	.....	65,000	43	46
22	....	....	.....	.....	60,000	43	46
23	....	....	.....	.....	62,500	44	46
24	....	....	.....	.....	65,000	45	48
25	....	....	.....	.....	25,000	46	49
26	....	....	.....	.....	15,000	48	52
27	....	....	.....	.....	20,000	49	51
28	....	....	.....	.....	15,000	48	50
29	....	....	.....	.....	17,500	46	48
30	....	....	.....	.....	12,500	48	51
31	....	....	.....	.....	7,500	46	50
Jan. 1	....	....	.....	.....	12,500	46	50
2	....	....	.....	.....	17,500	47	50
3	....	....	.....	.....	7,500	47	50
4	....	....	.....	.....	5,000	47	51
5	....	....	.....	.....	10,000	48	50
6	....	....	.....	.....	15,000	50	51
7	....	....	.....	.....	12,500	46	48
Total.	5,719	3,065	8,784	48,527,000	3,395,000	....	....

As soon as the eggs had been fertilized they were hauled in wagons from the fishing-grounds to the hatchery (about two-thirds of a mile), where they were placed in baskets until eyed and ready for shipment. The first consignment was forwarded to Sisson on November 16, and shipments continued from that time until January. Of the total number collected 24,000,000 were turned over to the California Commission, to be hatched on the Sacramento and Eel rivers; 4,000,000 were sent to Baird; 6,000,000 were sent east on car No. 3; 2,000,000 were transferred to Bear Valley Station and 3,000,000 to Clackamas, Oreg.

The remaining 6,000,000 yielded 5,885,500 fry, which were liberated in Battle Creek between December 16 and February 28, on which date the station was closed and placed in charge of a watchman. The total loss of eggs during incubation was 3,395,000.

In December Mr. Cloudsley Rutter was detached from Battle Creek and ordered to Olema, Bear Valley, Cal., to hatch and liberate the 2,000,000 eggs transferred to that point. The loss during incubation was small, 1,970,000 fry being hatched, but owing to limited facilities for holding them in the hatchery it was found necessary to liberate them a few days after the bursting of the shell, in Olema Creek, Papermill Creek, Hatchery Pond, Hatchery Creek, and a brook near Inverness.

In depositing the fry, shoals or riffles were selected as the most suitable places. When the fry were first planted the creeks were very low, which enabled Mr. Rutter and his assistant to observe their movements closely. During the first nine days they moved neither up nor down stream, but collected in groups in shallow places. At one spot from 4,000 to 5,000 were found in an eddy behind a rock. After the heavy rain of February 1, however, no further traces of them could be seen. On February 26 the station was closed and observations were discontinued, owing to lack of funds. The grounds upon which the plants had been made were examined again on April 10 and very few fry were found in the creek, though enough had been planted to give 2 to every square foot of surface from the mouth to the highest point at which deposits were made.

FORT GASTON STATION, CALIFORNIA (W. E. DOUGHERTY IN CHARGE).

Owing to lack of rains during the summer and fall, very few salmon and no steelheads reached the traps in the spring; consequently no work was done at Fort Gaston. At Redwood large numbers of salmon were taken below the rack, but owing to lack of facilities only about half of them were used. During the year 1,410,000 steelhead eggs, 1,283,450 eggs of the chinook and nerka salmon, and 41,000 rainbow-trout eggs were collected; 710,000 steelhead eggs were shipped to eastern stations; the balance were hatched, and the fry resulting from the steelheads and the salmon were liberated in Redwood Creek. The rainbow-trout fry (35,950) were deposited in Mill, Pine, and Fish Tangatang creeks.

As these stations are practically inaccessible, it being necessary to pack on mules all material carried in and out, and as better results can

be secured more economically at other points, they were abandoned at the close of the year.

CLACKAMAS STATION, OREGON (W. F. HUBBARD, SUPERINTENDENT).

Arrangements were made to operate (in connection with Clackamas Station) substations on the Salmon and Little White Salmon rivers; also a hatchery belonging to the Columbia River Packers' Propagating Company on the headwaters of Clackamas River; and with Mr. R. D. Hume on Rogue River.

The rack across the Clackamas was finished early in July. Heretofore it had been constructed on a shallow riffle a short distance above the station, but this season the property-owners controlling the shores objected, and it became necessary to locate it directly opposite the station in much deeper water. During the summer the hatchery was overhauled and placed in thorough repair, new foundations, sills, and flooring being laid; many old troughs, which had been used since the establishment of the station, were replaced by new ones. The hatchery was further improved by putting in new skylights. The water supply, which had been very unsatisfactory in the past, was increased.

Early in September, all repairs and preparatory work having been completed, operations were commenced, but no ripe fish were taken until September 15. The fishing below the rack was continued every night, but very few fish were taken and only 386,650 eggs were collected in September. As the prospects for large collections in the vicinity of the station were poor, arrangements were made early in October, with Mr. G. H. Oldenburg, for collecting eggs at a point about 4 miles below the station, at the rate of 40 cents per 1,000, eyed; and 824,800 were secured from this source between October 20 and December 3, the eggs being delivered in good condition.

Fishing operations continued until October 24, when the water in the river rose so high that the men were compelled to stop work. They resumed on November 7, but by this time all the salmon in the vicinity of the rack had spawned. As a result of the season's work, 1,672,275 eggs were taken from the Clackamas River.

During September 1,066,600 eggs were received from Salmon River, and commenced hatching on the 16th. The fry from the first lot were not as strong as usual, which was attributed to the fact that the water at Clackamas Station, taken from Clear Creek, is between 10° and 15° warmer than that of Salmon River. As soon as the temperature fell there was no difference between the fry hatched from eggs collected on the Salmon and those on the Clackamas. Between October 19th and November 16th, 4,000,000 eggs were transferred from the Little White Salmon in four shipments, and on January 18 another consignment of 3,000,000 arrived from Battle Creek. These were in excellent condition, only 2,200 being lost in transit. Plants of fry were made from time to time, commencing October 7, in Clackamas River and Clear Creek, the last plant being made on April 28. As a result of the eggs collected at

the various substations and transferred to Clackamas, 10,029,796 fry and fingerling fish were liberated in tributaries of Clackamas River.

A noteworthy experiment was tried during the season with one basket of eggs. A lot of 20,009, collected October 30, were placed in a basket, and on the following day 208 dead ones were taken off. The basket was then covered so as to exclude light, and left undisturbed until the twenty-first day, when the eggs were picked over again and 365 dead ones removed. During the undisturbed period the top layer became covered with sediment so thick that the eggs were not visible beneath, but the lower side, owing to the current of water through the basket, was perfectly clean. A larger percentage than usual of these eggs hatched, and the fry were apparently good. This method, if it proves practicable on a large scale, will effect not only an economy of time and labor, but probably the saving of many eggs, as these are often killed by picking over during the critical stage, between the ages of 9 and 15 days. In November, owing to the overcrowded condition of the hatchery, it became necessary to provide additional room for the fry, which were hatching rapidly. Fifty new troughs, 24 feet long, were constructed and placed out of doors near the flume leading from the spring. This afforded ample room for holding the fry until they had arrived at the proper stage for planting. Two hundred thousand fry were held until April, and when liberated in Clear Creek they were between 2 and 3 inches in length.

In December 10,000 Loch Leven trout eggs were received from Northville, Mich., for the Oregon Fish Commission. These were hatched and planted at the request of Hon. H. D. McGuire during the months of March and April in Sucker Lake, Crystal Lake, and Clackamas River.

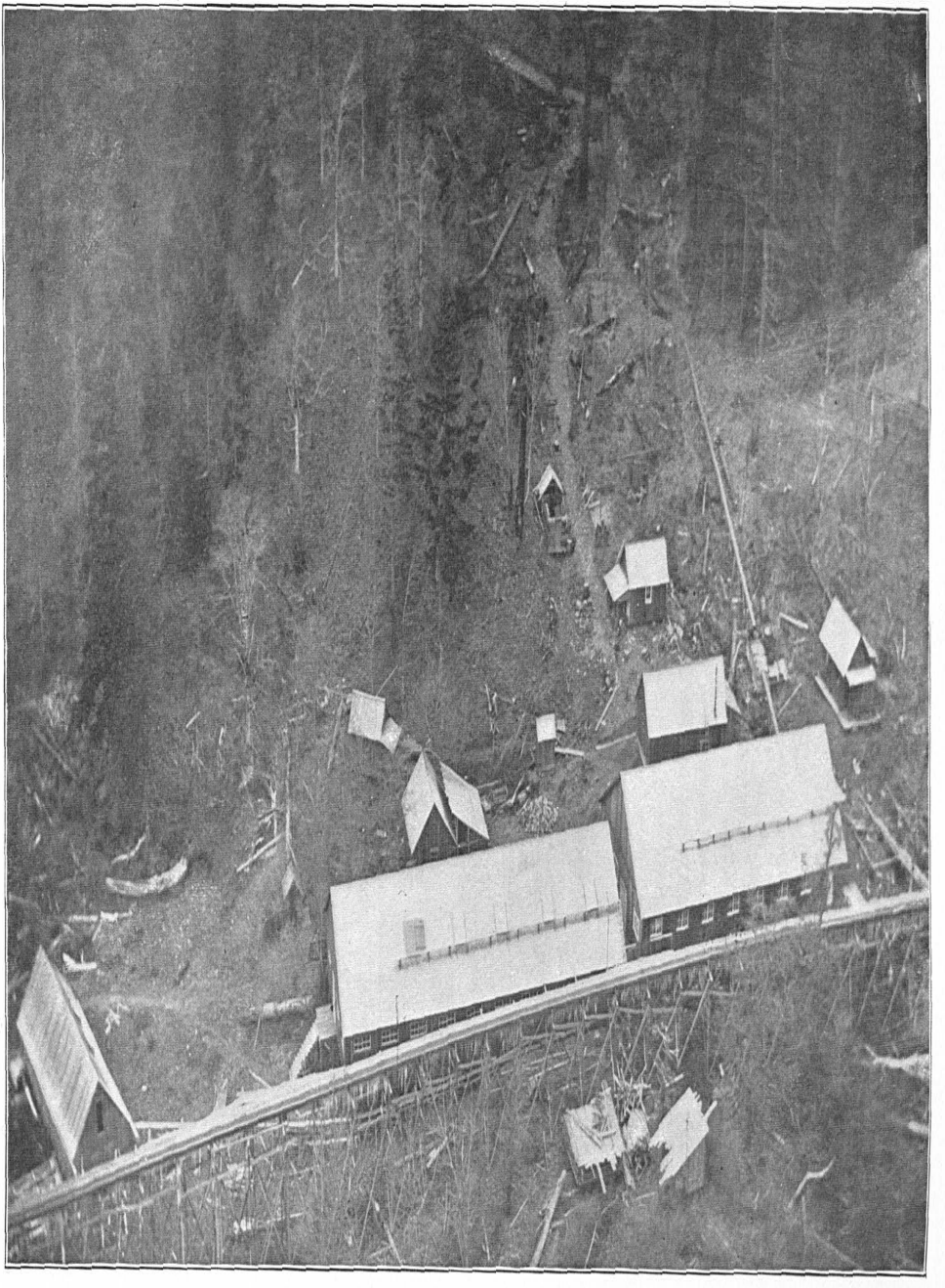
Upper Clackamas.

This hatchery was built in the spring of 1895 by the Columbia River Packers' Propagating Company of Oregon, at the headwaters of the Clackamas River, in the Cascade Mountains, about 50 miles from Clackamas, and operated by them for two years. At the suggestion of Hon. H. D. McGuire, fish commissioner of the State, it was turned over to the United States Fish Commission with the understanding that it would be operated to its full capacity during the fall. The hatchery is very inaccessible, and all supplies needed for the work have to be carried in on the backs of mules or men, as wagons can be used only over the first 20 miles, the last 30 being only a rough mountain trail. A trip to the station is difficult, requiring from two to three days, and as the country is entirely uninhabited it is necessary to camp en route. But the site is especially valuable from the fact that it is the spawning-ground of the earliest run of chinook salmon in the Clackamas River, and, except Salmon River, is the only place in the Columbia River Basin where eggs from this run can be secured as early as July. The station was first visited by the superintendent on June 16, and arrangements made to commence work under direction

of Mr. King Spurgeon. The property at the station consists of two sheds, 20 by 80 feet, which are used as hatcheries. These are cheap structures set upon posts, without sides or floors. There is also a log cabin 15 by 16 feet and a shanty 16 by 24 feet, made of cedar bark, for the accommodation of the men and storage of the necessary equipment for operating the station. The water supply is taken by gravity from a small spring brook.

In order to stop the ascent of the salmon, a contract was made at once to build a rack across the river. This was finished late in June, and another rack was constructed over Oak Grove Creek, a large tributary flowing into the Clackamas River below the station, where many salmon ascend to spawn. The fish commenced collecting below the racks before their completion, indicating that some had already passed up. On July 1 a crew of men was employed, the station was put in order, the troughs and baskets repaired and asphalted, the seining-grounds cleared, and a bridge built over Oak Grove Creek. The first collections were made on July 17, and operations continued daily from that time to the end of the season, the fish being caught with a seine hauled just below the rack. It was found necessary to build a second rack a short distance below the first, to prevent the fish from going down the river while fishing operations were in progress. This lower rack was constructed with a trap in the center, so that the fish might pass up, but could not return.

As the season advanced and the egg collections increased it became apparent that the water supply from the small brook would not be sufficient, and, as there was no way of increasing it, troughs were placed on a gravel bar near a riffle in the river, where there was fall enough to supply them with water from the river above; 12 hatching-troughs, 16 feet long, were placed on this riffle, and a rough shed was constructed over them. These troughs gave very good results, though they were in danger of being carried away by a sudden rise in the river; but this, fortunately, did not occur until the eggs had been removed. It also became necessary to rearrange the troughs in the sheds so that the water could be used over and over again, care being taken to aerate it as thoroughly as possible, and although the results were satisfactory, it is strongly urged that a better supply be secured for the next season. Between July 17 and August 26, there were taken and placed in the hatching-troughs 5,045,000 eggs. Those collected in July commenced hatching about the middle of August, and owing to the crowded condition of the troughs it became necessary to plant many of them a few days after hatching. The last fry hatched on October 15, the average period of incubation being from 34 to 35 days for the earlier lots and 50 days for the last. As soon as trough room permitted, the fry were held until the yolk-sac was nearly absorbed, when they were deposited on the spawning-grounds in Clackamas River. The station was closed when the last plant of fry was made on December 14, the property stored, and buildings left in charge of a watchman.



LITTLE WHITE SALMON RIVER LOOKING NORTH, SHOWING THE TWO NEW HATCHERIES, OFFICE, AND MESS-HOUSE.

Salmon River.

Early in the spring of 1897 arrangements were made with Mr. Thomas Brown for collecting quinnat-salmon eggs on the Salmon River on the same terms as heretofore, viz: 40 cents per 1,000 for eyed eggs, the construction of the rack, capture of the fish and care of the eggs until they reached that stage to be undertaken by him, and the Commission to furnish the necessary troughs and other hatching apparatus. The rack was placed across the Salmon River in May, at the same point where operations had been conducted the previous season, and another rack was built across the Sandy River later in the season for the purpose of turning the salmon from that stream into the Salmon River. At the beginning of the year, when the racks were completed, numbers of fish appeared below them, and indications pointed to a large collection of eggs; but many fish were captured before the spawning season by fishermen and others living in the vicinity, which materially reduced the available supply.

The first eggs were taken on July 22 and the last during the latter part of August. During this period 1,216,600 eggs were secured from the 389 females; of these, 1,066,600 were shipped to Clackamas in four consignments during September, and the balance were hatched and liberated in the river near the rack.

Rogue River.

During the early spring an investigation of various sites on the Rogue River was made by the superintendent, with a view to establishing an auxiliary station for collecting quinnat-salmon eggs. A number of sites were examined in the vicinity of Gold Hill, and a point was selected about 12 miles above that place, the water to be secured from an irrigation ditch connected with Rogue River; but before the arrangements could be completed with the parties owning the land, who lived at Jacksonville, Oreg., Mr. R. D. Hume, of Wedderburn, Oreg., agreed to erect a hatchery on Rogue River and equip it, provided the United States Fish Commission would operate it. This offer was accepted and the site near Gold Hill abandoned. The point selected by Mr. Hume is at the mouth of Elk Creek, about 26 miles from Central Point. Arrangements were made with J. J. Pankey to build a rack across the river, capture the fish, and furnish eyed eggs to the Commission at the rate of 40 cents per 1,000. In August a hatching-house, 24 by 50 feet, was built on the banks of the river above, equipped with 8 hatching-troughs, 35 feet long, 12 inches wide, and 10 inches deep, and with a filtering-tank 12 feet long, 4 feet wide, and 3 feet deep in one end. The water supply was taken from Elk Creek, its temperature being from 12° to 14° warmer than that of Rogue River. In order to raise the water in the creek to a sufficient height, a dam 10 feet high and 100 feet long was built about 1,800 feet from the hatchery, the water being conveyed in a 2-foot flume.

In September Mr. G. H. Tolbert, fish-culturist, was detached from Fort Gaston Station and placed in charge of the work. The building

was completed shortly afterwards, and the presence of many salmon below the rack afforded a fair prospect for good collections. A few eggs were taken in September, but the bulk was collected in October. During October and November 2,027,000 eyed eggs were delivered by Mr. Pankey. The results were not satisfactory, as it is believed that there was a sufficient number of salmon in the river to have yielded at least 5,000,000 more if the fishing had been properly managed. One of the principal objections to this site is that there is no deep water below the rack in which fish can collect, and as soon as they become frightened by the seining operations they descend the river for several miles. The hatchery was not large enough to accommodate the number of eggs taken, and it became necessary to provide additional troughs outside the building. Quite a heavy loss occurred during incubation; the shells of the eggs appeared to be so tough that the fry could not burst through. It was noticed that those obtained from the Rogue River salmon were much larger than those collected on the tributaries of the Clackamas, three of them laid side by side measuring 1⅛ inches.

A great deal of rain fell during November, raising the water in Elk Creek and carrying away about 30 feet of the top of the dam; fortunately no damage resulted. On December 8 Mr. Tolbert was relieved and Mr. J. W. Berrian put in charge. As the weather became colder, ice and slush formed in the flume to such an extent that it was decided to liberate all of the fry and not run the risk of losing them in the troughs. The last plant was made on February 10, when the station was closed and left in charge of a watchman. The total number liberated was 1,910,045; they were deposited on the spawning-grounds in Rogue River, near Trail, Oregon.

Little White Salmon.

As the results secured the previous year indicated that large numbers of eggs could be obtained on the Little White Salmon River, arrangements were made to operate at that point on an extended scale. Mr. S. W. Downing, foreman of Alpena Station, was detailed to assist the superintendent, and reported for duty on July 20. The old hatchery, which had been floated from its foundations the previous winter by the rising of the Columbia River, was repaired and the hatching-troughs made ready for the reception of eggs. The mess-house was rebuilt and enlarged, and a rack was placed across the river. A new hatchery was also commenced and completed during the month of August. This building is a substantial structure of wood, 42 feet by 80 feet, and is so arranged that the roof is supported by the sides of the building, thereby leaving the entire floor space free of posts and giving more room for hatching operations. The floor is terraced uniformly from one end of the building in four sections, with a difference of 8 inches in elevation from one section to the next. On each of these a row of troughs runs lengthwise of the building, the troughs in each maintaining an elevation of 8 inches above those in the next, in conformity with the plan of the floor. They are fed with water conducted by a flume to

a supply-trough placed against the end wall. By this arrangement all of the troughs are at a uniform height from the floor, and the manipulation of eggs is much easier than where troughs of different heights are set upon a level. The building is lighted by skylights in the roof and by windows in the sides and ends.

Very few fish were seen during August, but in September they began to make their way up the river in considerable numbers. The first spawning salmon were noticed on September 12, when fishing was regularly undertaken. Within three days afterwards over 1,000,000 eggs had been collected. Various methods were employed in catching the fish, some being taken with traps and others with seines. One trap was built in the upper side of the rack, but very few fish were captured in it. The seining was done in a pool below the rack and at various points along the lagoon. The greater number of fish, however, were caught in traps built on the riffles some distance below the rack, into which the fish were driven by hauling a seine downstream and forcing them into the trap. As soon as the spawning season commenced a large force was employed and work continued night and day. By September 28 all of the hatching-baskets at the station were filled with eggs, 11,286,000 having been collected; and as there were many spawning salmon still in the river, it became necessary to provide additional apparatus. Hatching-baskets were transferred from Clackamas Station, and work was resumed on October 2; by the 6th these baskets had also been filled, bringing the collections up to 12,649,000. The actual number of days on which eggs were taken was 22, making the daily average 575,000. The greatest number taken on one day was on September 22, when 1,155,000 were collected.

In order to simplify the handling of large females, they were knocked on the head with a club before any effort was made to strip them. This blow stunned the fish, and it was possible to express the eggs without any struggling or muscular contractions on the part of the fish, thereby saving much time and labor. The eggs were fertilized in the usual way, four men being detailed to take the fish from the corrals, strip them, impregnate, wash, and transfer the eggs to the hatchery. As a rule, the eggs were allowed to remain in the pan about an hour before being washed, but with the last million obtained this period was reduced to a few minutes. These eggs were transferred to the hatchery, and proved to be better than any of the earlier collections.

The spawning season here lasts only a month, but during that period the river is alive with fish, and it is believed that former collections could be largely exceeded, as at no time was it necessary for the men to fish more than a few hours a day. Fortunately the weather during the hatching season was pleasant; otherwise the fish in the troughs on the outside would have undoubtedly been killed by ice. Several severe snowstorms occurred, but no damage was done.

On October 18 Mr. Downing was detached from the station, and Mr. J. A. Tolbert was placed in charge as foreman. As soon as the spawn-

ing season was completed additional troughs were constructed and placed out of doors for the accommodation of the fry. The eggs commenced hatching in November, and the first plant of fry was made on December 18. Plants continued from this time until January 29, when the last were liberated in Little White Salmon River, which is one of the best natural spawning-grounds of the quinnat salmon. The total number of fry planted was 7,391,000. After all had been disposed of the station was closed, and the watchman was employed for the balance of the year in constructing a road from the station to the county road.

SIUSLAW RIVER STATION, OREGON (L. E. BEAN IN CHARGE).

At the urgent request of the Representatives of the State of Oregon, and with the understanding that the canners and fishermen on Siuslaw River would cooperate with the U. S. Fish Commission, arrangements were again made to open the hatchery near Mapleton, Oreg., the owner having tendered its use free of cost.

In August Mr. L. E. Bean was placed in charge, and arrangements were made for collecting salmon down the river and transferring them in live-boxes to the hatchery, to be held until ready to spawn. A rack was placed across the north fork and another on the main river, 1½ miles above the station, at the head of tide water. Crates were also constructed for transferring the fish; they were 18 feet long, 9 feet wide, and 6 feet deep, and so made as to exclude light, sufficient space being left between the planks below the surface of the water to admit of the free circulation of water.

A collection of 100 salmon obtained from the seine of Capt. William Kyle were transferred to the boxes, but half of them were lost immediately after being placed in the live-boxes, and the balance died in transit, though the utmost care was exercised in handling them. This method was then abandoned and collections were made by means of gill nets and a trap fished below the rack, the trap being made of two old seines. A few fish were caught in this way while the water was muddy, but as soon as it became clear they avoided the traps. The majority were taken in gill nets set in the evening and fished from time to time during the night in the deep holes below the rack. Two nets were used, one of which was 30 fathoms long, 7-inch mesh, and the other 20 fathoms long, 9-inch mesh. On the night of October 21, 63 chinooks were taken in the two nets. The majority of those taken in the 9-inch mesh were injured and died in a short time; the others were held until the close of the season with comparatively small loss.

At the close of operations there were 117 ripe females and 97 males in the live-boxes. These yielded 544,275 eggs, of which 104,000 died in incubation. They were placed in the hatchery as soon as fertilized, and hatched during the month of January. The 440,275 fry resulting from them were liberated at suitable points in Spring Creek and the Siuslaw River during the latter part of February and the first of March.

LITTLE WHITE SALMON RIVER, SHOWING HATCHERIES AND LUMBER FLUME.

DISTRIBUTION TABLES.

The following tables show the distribution of fishes by States and Territories, and the distribution in detail by species:

Résumé, by States and Territories, of the distribution and assignment of fish and eggs.

State or Territory.	Species.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Alabama	Rainbow trout			1,000
Arizona	Rainbow trout			2,000
	Black bass, large-mouth			650
	Rock bass			400
	Strawberry bass			400
Arkansas	Rainbow trout			11,200
	Black bass, large-mouth			2,250
	Rock bass			1,600
	Strawberry bass			1,800
California	Quinnat salmon	30,255,000	15,643,300	
	Steelhead trout		650,000	
	Loch Leven trout	15,000		
	Rainbow trout		35,885	4,085
	Brook trout	85,000		
Colorado	Loch Leven trout			8,000
	Rainbow trout		7,000	
	Black-spotted trout		199,000	
	Brook trout		561,000	91,600
	Yellow-fin trout		7,500	
	Black bass			400
Connecticut	Shad		9,775,000	
	Atlantic salmon	100,000		
	Landlocked salmon	10,000		
	Rainbow trout	25,000		800
	Brook trout	10,000	20,000	
	Lake trout	300,000		
	Black bass, large-mouth			200
Delaware	Shad		15,479,000	
	Rainbow trout			570
	Black bass, large-mouth			400
	Crappie			100
District of Columbia	Shad	5,179,000	1,717,000	3,036,000
	Loch Leven trout		1,000	
	Lake trout		1,000	
Georgia	Rainbow trout			4,800
Idaho	Black-spotted trout		8,000	
	Brook trout			5,000
	Lake trout	10,000		
Illinois	Black bass, large-mouth			2,025
	Crappie			475
Indiana	Loch Leven trout		5,000	
	Brook trout		15,000	
	Lake trout		30,000	
	Black bass, large-mouth			4,415
	Crappie			700
Indian Territory	Rainbow trout			5,250
	Black bass, large-mouth			400
	Rock bass			680
	Strawberry bass			700
Iowa	Rainbow trout		3,000	800
	Brook trout		18,700	2,000
	Lake trout		441,000	
	Black bass, large-mouth			300
	Crappie			200
	Strawberry bass			100
Kansas	Rainbow trout			1,950
	Black bass, large-mouth			3,041
	Crappie			215
	Rock bass			2,000
Kentucky	Rainbow trout			1,600
	Black bass, large-mouth			1,535
	Crappie			550
	Rock bass			221
	Strawberry bass			242
Maine	Quinnat salmon	50,000	901,060	229,800
	Atlantic salmon		1,975,068	220,335
	Landlocked salmon	66,243		79,990
	Steelhead trout	50,000	58,907	6,172
	Rainbow trout			355
	Brook trout	25,000	356,721	
	Lake trout	75,000	55,998	
	Scotch sea trout			1,489
	Golden trout	10,000	79,144	
	Lobster		21,500,000	
Maryland	Shad	68,881,000	65,867,000	
	Rainbow trout	25,000		19,595
	Black bass, large-mouth			3,720
	Black bass, small-mouth			300
	Rock bass			200
Massachusetts	Shad		540,000	

Résumé of the distribution and assignment of fish and eggs—Continued.

State or Territory.	Species.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Massachusetts	Quinnat salmon			200
	Atlantic salmon			100
	Landlocked salmon	10,000		5,548
	Steelhead trout			200
	Rainbow trout	10,000		2,680
	Brook trout		80,000	
	Lake trout	100,000		
	Scotch sea trout			100
	Black bass, large-mouth			640
	Black bass, small-mouth			30
	Codfish		202,570,000	
	Pollock		4,455,000	
	Flatfish		39,337,000	
	Lobster		71,334,000	
Michigan	Landlocked salmon	10,000		
	Steelhead trout		91,000	3,500
	Loch Leven trout		3,000	
	Rainbow trout			8,000
	Brook trout		170,000	24
	Lake trout		6,268,400	
	Whitefish		8,198,000	
	Black bass, large-mouth			1,550
Minnesota	Steelhead trout		115,000	
	Brook trout		66,550	
	Lake trout		1,713,000	
	Black bass, large-mouth			750
	Crappie			400
Missouri	Rainbow trout		14,000	25,205
	Black bass, large-mouth			2,635
	Crappie			25
	Rock bass			800
	Strawberry bass			1,300
Montana	Steelhead trout			43,500
	Rainbow trout		3,000	
	Black-spotted trout		24,000	
	Brook trout	2,000		15,967
	Grayling		1,500,000	
Nebraska	Rainbow trout		4,000	14,000
	Brook trout			5,000
	Black bass, large-mouth			130
	Rock bass			200
	Strawberry bass			70
New Hampshire	Atlantic salmon	100,000		
	Landlocked salmon	10,000		10,000
	Steelhead trout		30,000	
	Rainbow trout		4,300	
	Brook trout	25,000	54,975	
	Whitefish	200,000		
	Lobster		1,200,000	
New Jersey	Shad		11,110,000	
	Landlocked salmon	10,000		
	Steelhead trout		12,800	
	Rainbow trout			2,000
	Brook trout	20,300		
	Black bass, large-mouth			2,350
New Mexico	Rainbow trout			2,100
	Black bass, large-mouth			500
	Rock bass			200
	Strawberry bass			800
New York	Shad		5,800,000	
	Quinnat salmon		4,691,800	260
	Atlantic salmon	100,000	97,071	200
	Landlocked salmon	15,000		16,000
	Steelhead trout		90,060	200
	Loch Leven trout		6,282	
	Rainbow trout		19,012	500
	Brook trout		84,152	
	Lake trout	200,000	1,000,971	
	Pike perch		10,043,750	
	Black bass, large-mouth			800
North Carolina	Shad	1,811,000	6,932,000	
	Rainbow trout			11,500
	Black bass, large-mouth			600
	Crappie			100
	Rock bass			1,715
North Dakota	Black bass, large-mouth			3,010
	Crappie			160
Ohio	Loch Leven trout	5,000		
	Rainbow trout			300
	Brook trout	2,000	29,000	
	Lake trout		908,800	
	Whitefish		80,290,000	
	Pike perch		71,110,000	
	Lake herring		18,970,000	
	Black bass, large-mouth			2,230
	Black bass, small-mouth			20
	Sunfish			60

Résumé of the distribution and assignment of fish and eggs—Continued.

State or Territory.	Species.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Ohio	Rock bass			940
	Strawberry bass			100
Oklahoma Territory	Rainbow trout			4,100
	Black bass, large-mouth			2,500
	Rock bass			4,800
	Strawberry bass			400
Oregon	Quinnat salmon		16,915,506	
	Loch Leven trout		5,175	
	Brook trout			6,300
Pennsylvania	Shad		8,250,000	
	Atlantic salmon	100,000		
	Landlocked salmon		3,025	
	Rainbow trout			23,000
	Brook trout		5,000	1,000
	Rock bass			2,310
Rhode Island	Landlocked salmon	5,000		1,550
	Brook trout		10,000	
	Lake trout		8,000	
	Black bass, large-mouth			1,300
	Black bass, small-mouth			460
	Lobster		1,200,000	
South Carolina	Shad		2,000,000	
	Black bass, large-mouth			500
	Crappie			250
	Rock bass			500
South Dakota	Black-spotted trout		14,400	
	Brook trout		21,000	6,500
	Lake trout		28,000	
Tennessee	Rainbow trout		225	9,631
	Black-spotted trout		3,000	
	Black bass, large-mouth			2,706
	Black bass, small-mouth			65
	Crappie			172
	Rock bass			1,436
Texas	Rainbow trout			3,975
	Black bass, large-mouth			30,405
	Crappie			50
	Rock bass			3,700
Utah	Rainbow trout		4,000	
	Brook trout	60,000	20,000	12,000
Vermont	Landlocked salmon	10,000	3,920	8,000
	Steelhead trout		60,587	
	Rainbow trout		700	2,250
	Brook trout	20,000	334,700	
	Lake trout	300,000	18,800	
	Black bass, large-mouth			450
Virginia	Shad		21,085,000	
	Rainbow trout			91,976
	Black bass, large-mouth			1,200
	Black bass, small-mouth			1,000
	Crappie			72
	Rock bass			1,350
Washington	Quinnat salmon		7,391,886	
	Black-spotted trout		5,000	
	Brook trout	25,000		11,000
West Virginia	Rainbow trout			3,400
	Black bass, large-mouth			300
	Rock bass			300
Wisconsin	Landlocked salmon	10,000		
	Steelhead trout		5,000	
	Brook trout		17,000	
	Lake trout		1,790,000	
	Black bass, large-mouth			1,800
Wyoming	Black-spotted trout		5,000	
	Brook trout			5,000
Foreign countries:				
Italy	Quinnat salmon	50,000		
	Landlocked salmon	5,000		
	Rainbow trout	20,000		
Germany	Quinnat salmon	50,000		
	Steelhead trout	10,000		
Japan	Quinnat salmon	100,000		
France	Quinnat salmon	100,000		
	Rainbow trout	10,000		
Belgium	Landlocked salmon	10,000		
	Rainbow trout	10,000		
Portugal	Rainbow trout	10,000		
England	Rainbow trout	20,000		
	Brook trout	10,000		
Austria	Brook trout	10,000		
Switzerland	Brook trout	25,000		
	Lake trout	100,000		
Canada	Lake trout		257,250	
Mexico	Black bass, large-mouth			300
Totals		108,871,543	744,445,346	4,192,057

Details of distribution.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Shad:			
Connecticut State Fish Commission, Lime, Conn		9,775,000	
Brandywine River, Wilmington, Del		9,479,000	
Smyrna Creek, Clayton, Del		780,000	
Leipsic Creek, Cheswold, Del		780,000	
St. John Creek, Dover, Del		840,000	
Murderkill Creek, Felton, Del		960,000	
Mispillion Creek, Milford, Del		780,000	
Blackbird Creek, Middletown, Del		420,000	
Indian River, Millsboro, Del		1,440,000	
Potomac River, near Aqueduct Bridge, D. C	5,179,000		
Potomac River, near Bathing Beach, D. C		50,000	
Potomac River, off Fish Lakes, D. C			3,036,000
Anacostia River, near Twining City, D. C		773,000	
Anacostia River, near Bonning, D. C		894,000	
Chesapeake Bay, Battery Haul, Md	32,343,000	19,829,000	
Chesapeake Bay, off Battery Station, Md	13,552,000	4,489,000	
Chesapeake Bay, Havre de Grace, Md	5,611,000		
Chesapeake Bay, Back Channel, Md	358,000		
Chesapeake Bay, Western Shoals, Md	6,923,000		
Chesapeake Bay, Oakington Channel, Md	300,000	1,419,000	
Chesapeake Bay, Eastern Channel, Md	6,368,000		
Chesapeake Bay, Wild Duck, Md	900,000		
Chesapeake Bay, Perryville, Md		210,000	
Chesapeake Bay, Spesutia Narrows, Md		824,000	
Northeast River, Red Bank, Md	2,526,000		
Bush River, at Bush River Station, Md		2,500,000	
Gunpowder River, Gunpowder Station, Md		3,075,000	
Northeast River, Northeast, Md		1,200,000	
Wicomico River, Salisbury, Md		625,000	
Chester River, Chestertown, Md		625,000	
Tuckahoe Creek, Queen Anne, Md		625,000	
Swan Creek, Swan Creek, Md		450,000	
Susquehanna River, off Watson Island, Md		1,000,000	
Susquehanna River, Port Deposit, Md		800,000	
Elk Creek, Elkton, Md		800,000	
Mill Creek, Mill Creek, Md		1,000,000	
Potomac River, Bryan Point, Md		11,781,000	
Potomac River, off Chapman Bar, Md		4,001,000	
Potomac River, off Swan Creek, Md		1,717,000	
Potomac River, off Bar Landing, Md		1,796,000	
Potomac River, off Moxley Point, Md		3,287,000	
Potomac River, off Broad Creek, Md		2,102,000	
Potomac River, off Piscataway Creek, Md		1,712,000	
Parker Mill Ponds, Wareham, Mass		270,000	
Snipatuit Pond, Middleboro, Mass		270,000	
Salem Creek, Salem, N. J		600,000	
Manasquan River, Farmingdale, N. J		800,000	
Metedeconk River, Lakewood, N. J		800,000	
Toms River, Whites, N. J		800,000	
Delaware River, Milford, N. J		3,150,000	
Delaware River, Lambertville, N. J		4,500,000	
Delaware River, Burlington, N. J		460,000	
Delaware River, Port Jervis, N. Y		300,000	
Hudson River, Newburg, N. Y		2,500,000	
Hudson River, New York State Fish Commission, N. Y		3,000,000	
Albemarle Sound, Edenton, N. C	111,000	3,319,000	
Albemarle Sound, Mackey Ferry, N. C	1,700,000	713,000	
Perquimans River, Hertford, N. C		900,000	
Neuse River, Goldsboro, N. C		666,000	
Tar River, Tarboro, N. C		400,000	
Six Runs Creek, Elliott, N. C		534,000	
Northeast Branch of Cape Fear River, Wallace, N. C		400,000	
Susquehanna River, Peach Bottom, Pa		900,000	
Susquehanna River, Fites Eddy, Pa		450,000	
Delaware River, Bristol, Pa		6,000,000	
Delaware River, Delaware Water Gap, Pa		900,000	
Pee Dee River, Pee Dee, S. C		375,000	
Santee River, crossing Atlantic Coast Line R. R., S. C		388,000	
Santee Canal, crossing Atlantic Coast Line R. R., S. C		387,000	
Edisto River, Colleton County, S. C		309,000	
Ashepoo River, Colleton County, S. C		271,000	
Combahee River, Colleton County, S. C		270,000	
King Capsico River, Mount Holly, Va		300,000	
Nansemond River, Suffolk Va		715,000	
Potomac River, off White House, Va		781,000	
Potomac River, off Mount Vernon, Va		3,168,000	
Potomac River, Occoquan Bay, Va		8,552,000	
Potomac River, off Craney Island, Va		3,243,000	
Potomac River, off mouth of Pohick Creek, Va		2,546,000	
Potomac River, off Hunting Creek, Va		1,011,000	
Potomac River, off Colinwood, Va		918,000	
Potomac River, off Ferry Landing, Va		451,000	
Total	75,871,000	149,155,000	3,036,000

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Quinnat salmon:			
California Fish Commission, Sisson hatchery, Cal	22,255,000		
California Fish Commission, Eel River hatchery, Cal	8,000,000		
Olema Creek, Olema, Cal		850,000	
Papermill Creek, Olema, Cal		250,000	
Papermill Creek, Tocaloma, Cal		570,000	
Bear Valley Creek, Olema, Cal		250,000	
Sinoll Creek, Inverness, Cal		50,000	
Redwood Creek, Redwood Station, Cal		1,060,000	
Ulinor Creek, near Redwood Station, Cal		200,000	
Supply Creek, near Fort Gaston, Cal		16,000	
McCloud River, Baird, Cal		6,511,800	
Battle Creek, Battle Creek Station, Cal		5,885,500	
Long Pond, Bucksport, Me			29,691
Penobscot River, Orrington, Me			17,182
Penobscot River tributary, Prospect, Me			6,747
Brewer Pond, Bucksport, Me			19,982
Penobscot River, Millford, Me			4,994
Penobscot River, Bradley, Me			9,994
Sweet Pond, Orrington, Me			5,000
Penobscot River, Eddington, Me			7,485
Penobscot River, Brewer, Me			20,423
Penobscot River, North Milford, Me			2,493
Alamoosook Lake, Orland, Me			65,896
Toddy Pond, Surry, Me			27,816
Hancock Pond, Bucksport, Me			2,799
Heart Pond, Orland, Me			6,066
Toddy Pond, Orland, Me			3,032
Craig Pond, Orland, Me			200
Maine Fish Commission, Monmouth, Me	35,000		
Charles E. Oak, Caribou, Me	15,000		
Union River, Ellsworth, Me		901,066	
New England Sportsmen's Association, Boston, Mass			200
Lake Ontario, Tippet Point, N. Y		1,000	
St. Lawrence River, Cape Vincent, N. Y		2,033,000	
Salmon River, Pulaski, N. Y		328,000	
Lake Ontario, off Grenadier Island, N. Y		2,329,800	
Battery Park Aquarium, New York City, N. Y			200
Clackamas River and Clear Creek, Stone, Oreg		7,933,770	
Clackamas River, Stone, Oreg		2,076,026	
Clackamas River, Garfield, Oreg		4,390,000	
Salmon River, Salmon, Oreg		145,396	
Rogue River, Trail, Oreg		1,910,045	
Swing Creek, Mapleton, Oreg		85,000	
Siuslaw River, Mapleton, Oreg		280,000	
Sweet Creek, Mapleton, Oreg		75,275	
Wilson River, Wilson, Oreg		19,994	
Little White Salmon River, Chenowith, Wash		7,391,886	
Prof. D. Vinciguerra, Rome, Italy	50,000		
S. Jaffe, Sandfort, Germany	50,000		
M. Funohoshi, Niigataken, Japan	100,000		
Director Zoologique d'Acclimatation, Paris, France	100,000		
Total	30,605,000	45,543,558	230,200
Atlantic salmon:			
Connecticut Fish Commission, Windsor Locks, Conn	100,000		
Alamoosook Lake, Orland, Me			46,023
Toddy Pond, Orland, Me			78,844
Toddy Pond, Surry, Me		196,736	42,462
Craig Pond, Orland, Me			11,640
Penobscot River, Bangor, Me			2,495
Penobscot River, North Milford, Me			2,405
Penobscot River, Passadumkeag, Me		220,000	14,918
Heart Pond, Orland, Me			5,250
Green Lake, Otis, Me			16,208
Penobscot River, Milford, Me		150,000	
Penobscot River, Costigan, Me		160,000	
Penobscot River, Lincoln Center, Me		220,000	
Penobscot River, Mattawamkeag, Me		222,500	
Penobscot River, Winn, Me		170,000	
Long Pond, Bucksport, Me		119,051	
St. Croix River, Vanceboro, Me		137,500	
Williams Pond, Bucksport, Me		39,281	
Pleasant River, Brownville, Me		340,000	
New England Sportsmen's Association, Boston, Mass			100
State Fish Commission, Laconia, N. H	100,000		
Henry M. Davidson, Old Forge, N. Y	100,000		
Battery Park Aquarium, New York City, N. Y			200
St. Lawrence River, Cape Vincent, N. Y		97,071	
State Fish Commission, Allentown, Pa	100,000		
Total	400,000	2,072,139	220,635

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Landlocked salmon:			
Connecticut Fish Commission, Windsor Locks, Conn	10,000		
Duck Lake, Winn, Me			3,750
Sebec Lake, Dover, Me			2,500
Pearl Mill Stream, Brewer Junction, Me			3,750
Green Lake, Dedham, Me			421
Donnell Pond, Franklin Road, Me			5,000
Field Pond, Brewer Junction, Me			5,250
King and Bartlett lakes, Farmington, Me			3,000
Lake George, Skowhegan, Me			5,250
Lake George, Thorndike, Me			6,300
Bemis Creek, Bemis, Me			3,000
Alligator Lake, Great Pond, Me			1,000
Tunk Pond, Franklin Road, Me			1,500
Embden Lake, Oakland, Me			1,500
Brewer Pond, Brewer Junction, Me			1,500
Green Lake, Otis, Me			6,159
Toddy Pond, Orland, Me			1,960
Varnum Pond, Farmington, Me			3,300
Alford Lake, Rockland, Me			1,500
Half-mile Pond, Great Pond, Me			3,000
Lead Mountain Pond, Ellsworth Falls, Me			5,000
Hayden Lake, Skowhegan, Me			3,750
Moose Pond, Hartland, Me			3,000
Old Meadow Stream, Franklin Road, Me			5,000
Swan Lake, Belfast, Me			1,800
Richardson Lake, Rumford Falls, Me			1,800
Commodore Club, Hartland, Me	10,000		
Wild Goose Club, Wilson's Mills, Me	15,000		
Maine Fish Commission, Enfield, Me	41,243		
Podunk Pond, Brookfield, Mass			4,000
Pratt Pond, Upton, Mass			1,548
State Fish Commission, Winchester, Mass	10,000		
State Fish Commission, Detroit, Mich	10,000		
State Fish Commission, Laconia, N. H	10,000		
East Lake, Wakefield, N. H			5,000
Penacook Lake, Concord, N. H			5,000
A. M. Bigelow, Branchville, N. J	10,000		
J. D. Moroley, Lake Pleasant, N. Y	5,000		
Tuxedo Club, Tuxedo Park, N. Y	10,000		
Catskill Creek, Catskill, N. Y			6,000
Lake George, Caldwell, N. Y			4,800
Lake Champlain, Port Henry, N. Y			5,000
Battery Park Aquarium, New York City, N. Y			200
Eaglemere Lake, Eaglemere, Pa		3,085	
State Fish Commission, Westerly, R. I	5,000		
Easton Pond, Newport, R. I			1,550
State Fish Commission, Roxbury, Vt	10,000		
Caspian Lake, Greensboro, Vt		1,420	
Lake Morey, Fairlee, Vt		2,500	
Lake Willoughby, West Burke, Vt			2,000
Derby Pond, Newport, Vt			4,000
Salem Pond, Newport, Vt			2,000
State Fish Commission, Bayfield, Wis	10,000		
Prof. D. Vinciguerra, Rome, Italy	5,000		
Dr. R. Vandenhenden, Belgium	10,000		
Total	171,243	7,005	121,088
Steelhead trout:			
Redwood Creek, Bair's Ranch, Cal		650,000	
Commodore Club, Hartland, Me	50,000		
Alamoosook Lake, Orland, Me		10,032	6,172
Tributaries of Great Brook, Otis, Me		8,700	
Abraham and Molasses ponds, Eastbrook, Me		14,266	
Toddy Pond, Surry, Me		19,709	
Craig Pond, Orland, Me		2,200	
Heart Pond, Orland, Me		4,000	
New England Sportsmen's Association, Boston, Mass			200
Boardman River, Traverse City, Mich		10,000	
Hale Creek, Rose City, Mich		13,500	
Silver Creek, East Tawas, Mich		9,500	
Baldwin Creek, Baldwin, Mich		10,000	
Pere Marquette River, Baldwin, Mich		13,000	
Bear Creek, Thompsonville, Mich		10,000	
Cannon Creek, Williamsburg, Mich		5,000	
Little Manistee River, Manistee Crossing, Mich		10,000	
Washington River, Isle Royale, Mich		10,000	
South Fork of Pere Marquette River, Baldwin, Mich			500
Middle Fork of Pere Marquette River, Wingleston, Mich			1,000
Cold Creek, East Tawas, Mich			2,000
Pickwick Spring Lake, Lamoille, Minn		10,000	
Rolling Stone Creek, Winona, Minn		10,000	
Big and Little Trout brooks, Lamoille, Minn		10,000	

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Steelhead trout—Continued.			
Evans Lake, Duluth, Minn		5,000	
Lax Lake, Beaver Bay, Minn		5,000	
Temperance River, Temperance River, Minn		5,000	
Devil's Track River, Cook County, Minn		5,000	
Stewart River, Lake County, Minn		10,000	
French River, Duluth, Minn		10,000	
Sucker River, Duluth, Minn		15,000	
Lester River, Duluth, Minn		5,000	
State Fish Commission, St. Paul, Minn		25,000	
Mystic Lake, Mystic Lake, Mont			24,500
Willow Creek Lake, Pony, Mont			9,000
Applicants in Montana			10,000
Cocheco River, Dover, N. H		10,000	
Christine Lake, Stark, N. H		10,000	
Pleasant Pond, Manchester, N. H		10,000	
Big and Little Flat brooks, Branchville, N. J		12,800	
St. Lawrence River, Cape Vincent, N. Y		90,060	
Battery Park Aquarium, New York City, N. Y			200
Willoughby Lake, Westmore, Vt		4,975	
Lake Morey, Fairlee, Vt		2,498	
Missisquoi River, Swanton, Vt		2,703	
Lake Champlain, Isle La Motte, N. Y		24,411	
Crystal Lake, Barton, Vt		15,000	
Lake Champlain, Burlington, Vt		10,000	
Sleeper River, St. Johnsbury, Vt		1,000	
Brule River, Brule, Wis		5,000	
S. Jaffé, Osnabruck, Germany	10,000		
Total	60,000	1,113,354	53,572
Loch Leven trout:			
Capt. A. Rogers, Sisson, Cal	15,000		
Upper Twin Lakes, Lake County, Colo			8,000
Spring Pond, Lanier Heights, D. C		1,000	
St. Mary Lake, South Bend, Ind		5,000	
Cleveland Creek, Muskegon, Mich		3,000	
Applicants in New York		6,282	
Stranahan Bros., Hiram Station, Ohio	5,000		
Sucker Lake, Oswego, Oreg		3,000	
Clackamas River, Stone, Oreg		675	
Ladds Pond, Portland, Oreg		1,500	
Total	20,000	20,457	8,000
Rainbow trout:			
Lookout Lake, Gadsden, Ala			500
Spring Lake, Springville, Ala			300
Applicants in Alabama			200
Silver Creek, Holbrook, Ariz			1,000
Live Oak Creek, Flagstaff, Ariz			1,000
North Fork of White River, West Fork, Ark			3,000
North Fork of White River, Lilley, Ark			3,100
Frog Bayou, Mountainburg, Ark			2,000
Saline River, Benton, Ark			200
Applicants in Arkansas			1,800
Supply Creek, Hoopa Valley, Cal			2,755
Mill Creek, Hoopa Valley, Cal		9,485	1,230
Pine Creek, Weitchpec, Cal		11,950	
Fish Tangatang Creek, Trinity Summit, Cal		10,000	
Hennessey Creek, Burnt Ranch, Cal		3,950	100
Middle Evergreen Lake, near Leadville, Colo		5,000	
Applicants in Colorado		2,000	
State Fish Commission, for streams in State of Connecticut			800
State Fish Commission, Windsor Locks, Conn	25,000		
Tributaries of Delaware River, Wilmington, Del			570
Hermitage Heights Pond, Atlanta, Ga			500
Underwood Pond, Atlanta, Ga			300
Tallulah River, Blalock, Ga			1,000
Fouches Pond, Rome, Ga			500
Hiawassee River, Hiawassee, Ga			1,000
Head of Nottely River, Union County, Ga			1,000
Applicants in Georgia			500
Ballard Creek, Ballard Station, Ind. T			1,800
Barren Fork Creek, Barren Fork Station, Ind. T			1,750
Sallisaw River, Sallisaw, Ind. T			1,700
Applicants in Iowa		3,900	800
Mulberry Creek, Dodge City, Kans			950
Mill Pond in Buckner Creek, Jetmore, Kans			1,000
Laurel River, Corbin, Ky			1,100
Balkes Pond, Stine, Ky			500
Alamoosook Lake, Orland, Me			355
Bynum Run, Bellair, Md			500
Gunpowder River, Eklo, Md			500

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Rainbow trout—Continued.			
Spring Brooks, northwestern Maryland			1,000
Witt Creek, Cumberland, Md			750
Spring Brook, Finksburg, Md			500
Mountain Brook, Hagerstown, Md			500
Grave Run, Beckleysville, Md			500
Cherry Creek, in Garrett County, Md			995
Stony Run, Port Deposit, Md			500
Cabin Branch, Morgan, Md			1,000
Monocacy River, Dickerson, Md			500
Cabin Grant Creek, Florence, Md			700
Patuxent River, in Carroll and Montgomery counties, Md			800
Applicants in Maryland			1,850
State Fish Commission, Baltimore, Md	25,000		
Hamlin Pond, West Barnstable, Mass			1,000
Hadway Pond, Hyannis, Mass			660
Hinckley Pond, West Barnstable, Mass			1,000
New England Sportsmen's Association, Boston, Mass			20
S. R. Bennett, New Bedford, Mass	10,000		
Bear Creek and Miller Creek, Allegan, Mich			2,000
Sturgeon River, Rondo, Mich			2,000
Pere Marquette River, Baldwin, Mich			2,400
Pere Marquette River, Wingleton, Mich			800
Pere Marquette River, Stearns, Mich			800
Elm Springs, Fanning, Mo			986
Montgomery Lake, Osceola, Mo			1,900
Ash Cave Lake, Dixon, Mo			1,950
Five-mile Creek, Joplin, Mo			2,000
Shoal Creek, Neosho, Mo			354
Beaver Creek, Arlington, Mo			495
Spring Creek, Arlington, Mo			500
Hazleton Creek, Arlington, Mo			200
Indian Creek, Lanigan, Mo			4,800
Cowskin Creek, Noel, Mo			4,900
Minsey Lake, Forsyth, Mo			300
James River, Turner, Mo			1,000
Piney Creek, Cabool, Mo			1,000
Potter Creek, Cabool, Mo			1,000
Jack Fork of Current River, Mountain View, Mo			1,000
Bryan Fork of White River, Mansfield, Mo			1,000
Applicants in Missouri		5,000	1,820
Sac River and James River, Springfield, Mo		9,000	
Warm Spring Lake, Dillon, Mont		2,000	
Applicants in Montana		1,000	
Spring Brook and Lakes, Omaha, Nebr		4,000	2,000
State Fish Commission, South Bend, Nebr			12,000
Isinglass River, Dover, N. H		4,300	
Pequest River, Belvidere, N. J			500
Pequest River, Tranquillity, N. J			500
Frisa Pond, Williamstown, N. J			500
Applicants in New Jersey			500
Pecos River, Glorieta, N. Mex			950
Chama River, Chama, N. Mex			500
Lake Avalon, Eddy, N. Mex			175
Reservoir, Raton, N. Mex			475
Peekskill Hollow Creek, Peekskill, N. Y			300
Applicants in New York		2,200	200
Olympia Brook, Hunter, N. Y		5,000	
Mountain Stream, Peekskill, N. Y		5,906	
Brundage Creek, Johnsonville, N. Y		5,906	
Toe River, Cranberry, N. C			500
Laurel Creek, Asheville, N. C			500
Roaring Fork Creek, English, N. C			500
Briery Fork Creek, Calhoun, N. C			500
Shoal Creek, Calhoun, N. C			500
Allison Creek, Calhoun, N. C			500
Savannah Creek, Dillsboro, N. C			500
Dick Creek, Dillsboro N. C			500
Catawba Creek, Marion, N. C			500
Armstrong Creek, Marion, N. C			500
Little Buck Creek, Marion, N. C			500
Watauga River, Lenoir, N. C			1,000
Valley River, Murphy, N. C			500
Plum Tree Creek, Cranberry, N. C			500
Caney Fork Creek, Sylva, N. C			500
Junaluska Creek, Andrews, N. C			500
Rocky River, Liberty, N. C			500
Rocky Creek, Wilkesboro, N. C			500
Elk River, Elk Park, N. C			500
Applicants in North Carolina			1,500
Lake Erie, Toledo, Ohio			300
Spring Bark Creek, North Enid, Okla			1,000

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Rainbow trout—Continued.			
Applicants in Oklahoma			3,100
Rambo Creek, Norristown, Pa			500
Kelkoin Run, Bedford, Pa			300
Clover Creek, Henrietta, Pa			700
Mountain Creek, Pinegrove Furnace, Pa			1,000
West End Creek, Alderson, Pa			500
Muddy Creek, York, Pa			300
West Branch of Shickshinny Creek, Shickshinny, Pa			500
Blair Run, Altoona, Pa			300
Neshameny Creek, Penllyn, Pa			300
Nescopeo Creek, Upper Lehigh, Pa			500
Weisauking River, Rome, Pa			400
Stony Fork Creek, Cresson, Pa			300
Daly Brook, Smethport, Pa			250
Boyer Creek, Smethport, Pa			250
Cold Grove Brook, Smethport, Pa			250
Letort Spring, Carlisle, Pa			200
Beaver Run, Outlet Station, Pa			500
Potato Creek, Smethport, Pa			250
Indian Run, Smethport, Pa			250
Blacksmith Brook, Smethport, Pa			250
Robbins Brook, Smethport, Pa			250
Branch of Gunpowder Falls, New Freedom, Pa			300
Bluerock Creek, Hamburg, Pa			600
Rattlesnake Creek, Pittston, Pa			400
North Fork of Solomon Run, Johnstown, Pa			300
South Fork of Solomon Run, Johnstown, Pa			300
Hobliston Branch, Turnpike, Pa			300
Coboy Swamp Creek, Moosic, Pa			400
Webster Run, Mercersburg, Pa			300
Spring Brook, Lincoln University, Pa			600
Licking and Lost creeks, Mifflintown, Pa			300
Tea Brook, Reidsville, Pa			300
Coudersport Reservoir, Coudersport, Pa			800
Beaver Run, Westover, Pa			300
Norden Creek, Pittston, Pa			600
Fishing Creek, Lock Haven, Pa			2,500
Hay Creek, Birdsboro, Pa			300
Bailey Creek, Mansfield, Pa			300
Tioga River, Mansfield, Pa			200
Stone Creek, Huntingdon, Pa			300
Clover Creek, Altoona, Pa			300
Mahantong Creek, Shamokin, Pa			500
Elk Run, Johnstown, Pa			350
Kersey and Burns runs, Driftwood, Pa			500
Bear Valley Creek, Chambersburg, Pa			300
Falling Spring Creek, Chambersburg, Pa			400
Broadhead Creek, Creaco, Pa			1,500
Pennline Creek, Pennline, Pa			300
Conestoga Creek, Reading, Pa			200
Applicants in Pennsylvania			1,140
Tiger Creek, Morgan Springs, Tenn			500
Stone River, Murfreesboro, Tenn			500
Calf-killer River, Sparta, Tenn			500
Flint River, Fayetteville, Tenn			500
Duck River, Normandy, Tenn			1,000
Little River, Knoxville, Tenn			500
Little River, Notime, Tenn			500
Caney Fork River, Walling, Tenn			500
Tiger Creek, Hampton, Tenn			500
Green Brier Lake, Lebanon, Tenn			500
Dry Fork Creek, Greenville, Tenn			500
Roan Creek, Mountain City, Tenn			1,000
Shell Creek, Elizabethton, Tenn			500
Laurel Fork Creek, Hampton, Tenn			500
Applicants in Tennessee		225	1,631
Prairie Creek, Hutchins, Tex			800
Spring Creek, Dallas, Tex			1,500
Applicants in Texas			1,675
Silver Islet Lake, Park City, Utah		4,000	
Morse Pond, Montpelier, Vt			500
Beaver Ponds, Proctor, Vt			1,750
Clyde River, Derby, Vt		700	
Dart Creek, Winchester, Va			500
Buffalo Lake Run, Winchester, Va			500
Pohick Creek, Sideburn, Va			500
Thompson Mill Run, Millboro, Va			500
North River, Harrisonburg, Va			500
Mill Creek, Chilhowie, Va			2,200
Moomams Branch, Salem, Va			4,972

Details of distribution—Continued.

Species and distribution.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Rainbow trout—Continued.			
Reed Creek, Rural Retreat, Va			1,000
South Fork of Holstein River, Marion, Va			5,000
Mill Pond, Gate City, Va			4,980
Cascade and Dums Creek, Hot Springs, Va			6,800
Coldspring Branch, Glasgow, Va			4,980
Brush Creek, Christiansburg, Va			5,000
Reed Creek, Wytheville, Va			10,000
Cove Creek, Wytheville, Va			6,969
Cripple Creek, Beverly Furnace, Va			5,000
Back Creek, New River, Va			500
Back Creek, Dublin, Va			500
Walker's Little Creek, Pulaski City, Va			500
Big Moccasin Creek, Gate City, Va			500
Perrow Mill Pond, Lynchburg, Va			200
Indian Camp Creek, Coleman Falls, Va			500
Branch of North Anna River, Hewlett, Va			500
Walker Creek, New River, Va			500
Gunstock Creek, Big Island, Va			500
Black Creek, Radford, Va			2,500
Tate Run, Wytheville, Va			2,200
South Fork of Reed Creek, Crocketts, Va			2,500
South Fork of Reed Creek, Wytheville, Va			2,000
Stony Fork of Reed Creek, Wytheville, Va			1,800
South Fork of Reed Creek, Browning's Dam, Va			350
Applicants in Virginia			17,025
Meadow Branch, Cherry Run, W. Va			500
Trout and Meadow Runs, Romney, W. Va			500
Laurel Run, Caldwell, W. Va			500
Willow Grove Lake, Shenandoah Junction, W. Va			200
Elk Creek, Clarksburg, W. Va			1,000
Applicants in West Virginia			700
Augusto Nobre, Villa Daconde, Portugal	10,000		
William Burgess & Co., Malvern Wells, England	20,000		
Prof. D. Vinciguerra, Rome, Italy	20,000		
Dr. R. Vandenbenden, Belgium	10,000		
M. Raveret-Wattel, Fecamp, France	10,000		
Total	130,000	96,022	249,532
Black-spotted trout:			
Tomichi Creek, Parlin, Colo		10,000	
St. Mary Lake, Idaho Springs, Colo		3,000	
Fall River, Idaho Springs, Colo		5,000	
Naylor Lake, Georgetown, Colo		10,000	
Fryingpan Creek, on line of Colorado Midland Railway, Colo		20,000	
Silver Lake, Dillon, Colo		5,000	
Bledsoe Lake, Leadville, Colo		5,000	
Mammoth Lake and Creek and Middle and South Boulder creeks, Central City, Colo		20,000	
Platte River, Grant, Colo		4,000	
Platte River, Slaght, Colo		4,000	
Platte River, Bailey, Colo		4,000	
Platte River, Crosson, Colo		4,000	
Platte River, Pine Grove, Colo		4,000	
Platte River, Buffalo, Colo		4,000	
Platte River, Dome Rock, Colo		6,000	
Rio Grande River, Wagonwheel Gap, Colo		15,000	
Eagle River, Berry Station, Colo		20,000	
Tomichi Creek, Elko, Colo		8,000	
Twin Lakes, in Lake County, Colo		35,000	
Headwaters of Eagle River, McAllister Switch, Colo		7,000	
Applicants in Colorado		6,000	
Spirit Lake, Rathdrum, Idaho		4,000	
Applicants in Idaho		4,000	
Agnes Lake, Brown, Mont		4,000	
Middle Creek, Bozeman, Mont		3,000	
Bridger Creek, Bozeman, Mont		7,000	
Rocky Canyon Creek, Bozeman, Mont		3,000	
Bitter Root River, Missoula, Mont		4,000	
Applicants in Montana		3,000	
Polo Creek, Deadwood, S. Dak		3,000	
Castle Creek, Hill City, S. Dak		3,000	
Harney Peak Fish Lakes, Hill City, S. Dak		2,000	
Woods Lake, Rapid City, S. Dak		3,000	
Collins Springs, Dell Rapids, S. Dak		2,400	
Applicants in South Dakota		1,000	
Applicants at Nashville, Tenn		3,000	
Spokane River, Spokane, Wash		5,000	
Heart Lake, Sheridan, Wyo		5,000	
Total		258,400	

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Brook trout:			
W. F. Whittier, Sisson, Cal	50,000		
E. C. Tallant, Sisson, Cal	10,000		
Capt. A. Rogers, Sisson, Cal	25,000		
Clohesey Lake, Granite, Colo			5,000
Quartz Creek, Pitkin, Colo			5,000
Little Ohio Creek, Ohio City, Colo			5,000
North Fork of Cache Lapoudre Creek, Tie Siding, Colo			3,000
South Boulder and Mammoth creeks, Central City, Colo			20,000
Rio Grande River, Wagonwheel Gap, Colo			10,000
Tomichi Creek, Buxton, Colo			5,000
East River, Crested Butte, Colo			5,000
Mill Creek Lakes, Wolcott, Colo			3,000
Eagle River, Red Cliff, Colo			5,000
Middle Evergreen Lake, near Leadville, Colo			16,600
Applicants in Colorado		41,000	9,000
Lake San Cristoval, Lake City, Colo		20,000	
Crystal River, Carbondale, Colo		10,000	
Anderson Lake, Monte Vista, Colo		10,000	
Snake River, Dillon, Colo		10,000	
Molas Lake, Silverton, Colo		10,000	
Horn and Mera creeks, Cotopaxi, Colo		10,000	
Cache Lapoudre Creek, Fort Collins, Colo		40,000	
White River, Rifle, Colo		10,000	
Sarles Lake, Rockwood, Colo		5,000	
Park Lake, Monte Vista, Colo		10,000	
Eagle River, Barry Station, Colo		25,000	
Dallas River and Cow Creek, Ridgway, Colo		10,000	
Spring Creek, Montrose, Colo		10,000	
South Arkansas River, Salida, Colo		10,000	
Fryingpan River, Norrie, Colo		40,000	
North Fork of Platte River, Estebrook, Colo		10,000	
Platte River, Estebrook, Colo		5,000	
Platte River, Deansbury, Colo		10,000	
Platte River, Bailey, Colo		5,000	
Platte River, Cassell, Colo		5,000	
South Platte River, Ferndale, Colo		10,000	
Buffalo Creek, Buffalo, Colo		10,000	
Rainbow Lake and Starbend Creek, Gunnison, Colo		10,000	
Elk Creek, Pine Grove, Colo		10,000	
Geneva Creek, Cassell, Colo		5,000	
Blood River, Breckenridge, Colo		10,000	
North Fork of South Platte River, Slaghts, Colo		10,000	
North Fork of South Platte River, Estebrook, Colo		5,000	
North Fork of South Platte River, Webster, Colo		5,000	
North Fork of South Platte River, Chaseville, Colo		5,000	
North Fork of South Platte River, Meadows, Colo		10,000	
North Fork of South Platte River, Brookside, Colo		10,000	
North Fork of South Platte River, Crosson, Colo		5,000	
North Fork of South Platte River, Cliff, Colo		2,500	
North Fork of South Platte River, Dawson, Colo		2,500	
Mountain stream at Bailey, Colo		10,000	
North Fork of Geneva Creek, Cassell, Colo		5,000	
Craig Creek, Estebrook, Colo		5,000	
Lake and stream at Monument, Colo		10,000	
Reservoir at Jefferson, Colo		5,000	
Beaver Creek, Aberdeen Junction, Colo		10,000	
Clear Creek, Silver Plume, Colo		10,000	
Half-moon Lake, Leadville, Colo		10,000	
Deer Creek, Bailey, Colo		10,000	
East River, Gunnison, Colo		10,000	
West Marshall Creek, Gunnison, Colo		5,000	
Silver Creek, Salida, Colo		5,000	
Alder Creek, Alder, Colo		5,000	
Kerby Creek, Villa Grove, Colo		5,000	
Union Creek, Malta, Colo		10,000	
North Clear Creek, Central City, Colo		3,335	
South Boulder Creek, Central City, Colo		3,335	
Middle Boulder Creek, Central City, Colo		3,333	
Jenny Lind Creek, Central City, Colo		3,333	
Mammoth Creek, Central City, Colo		3,332	
Mammoth Lakes, Central City, Colo		3,332	
Tennessee Fork Creek, Leadville, Colo		10,000	
West Aspetuck River, New Milford, Conn		15,000	
Five Mile River, South Norwalk, Conn		5,000	
State Fish Commission, Windsor Locks, Conn	10,000		
Blue Lakes, Shoshone, Idaho			5,000
Hawkes Creek, Westville, Ind		5,000	
Spring Branch, Laporte, Ind		5,000	
Spring Branch, South Bend, Ind		5,000	
Spring Creek, Orchard, Iowa		5,000	
Silver Lake, Mount Vernon, Iowa		2,000	
Baker, Baldwin, and Bigall brooks, Cresco, Iowa		10,000	

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Brook trout—Continued.			
Applicants in Iowa		1,700	2,000
Lake Anasagunticook, Canton, Me		10,000	
Varnum and Clearwater ponds, Farmington, Me		16,000	
Water Company Reservoir, Belfast, Me		5,000	
Old Meadow Brook, Franklin Road, Me		10,000	
Sandy and Half-moon brooks, Thorndike, Me		10,000	
Brewer Pond, Brewer Junction, Me		10,000	
Tributaries of Great Brook, Otis, Me		50,000	
Green Lake, Green Lake, Me		46,721	
Oxford Lake, Rockland, Me		10,000	
Field Pond, Brewer Junction, Me		10,000	
Lake George, Skowhegan, Me		10,000	
Narragaugus Pond, Franklin Road, Me		10,000	
Thompson Pond, Oxford, Me		15,000	
Tunk Lake, Franklin Road, Me		10,000	
Surry Pond, Ellsworth, Me		5,000	
Branch Pond, Dedham, Me		70,000	
Flood Pond, Otis, Me		20,000	
Patten Pond, Ellsworth, Me		35,000	
Bangor and Aroostook R. R. Pond, Shirley, Me		10,000	
Parmacheenee Club, Camp Caribou, Me	25,000		
Punchbowl Pond, Falmouth, Mass		5,000	
Hicks and Purgatory ponds, Millbury, Mass		10,000	
Mountain Rock Brook, Lowell, Mass		10,000	
Dunklin Hole, Dedham, Mass		10,000	
Wilson Creek, Dedham, Mass		10,000	
Pawessett Pond, Dedham, Mass		20,000	
Trule Brook, Lowell, Mass		5,000	
Applicants in Massachusetts		10,000	
Allen Creek, Bronson, Mich		10,000	
Paint Creek, Ypsilanti, Mich		5,000	
Spring Brook, Chesaning, Mich		5,000	
Sturgeon River, Gaylord, Mich		5,000	
Au Sable River, Grayling, Mich		100,000	
McMaster Creek, Onaway, Mich		10,000	
Hays Creek, Grass Lake, Mich		5,000	
Brule River, Iron County, Mich		10,000	
Iron and Brule rivers, Iron County, Mich		15,000	
Washington River, Isle Royale, Mich		5,000	
Applicants in Michigan			24
North Branch of Sunrise River, North Branch, Minn		5,000	
Poplar River, Lutson, Minn		5,000	
Money Creek, Lamoille, Minn		5,000	
Pleasant Valley Creek, Lamoille, Minn		5,000	
Rush River, Winona, Minn		5,000	
Spring Brook, Northfield, Minn		10,000	
Colquet River, Duluth, Minn		5,000	
Five Springs, Lamoille, Minn		10,000	
Little Knife River and Silver Creek, Two Harbors, Minn		6,550	
Knife River, in St. Louis County, Minn		10,000	
Warm Bear Lake, Red Bluff, Mont			995
Odell Creek, Red Bluff, Mont			1,980
Cottonwood Creek, Bozeman, Mont			5,000
Trail Creek, Bozeman, Mont			5,000
Applicants in Montana			2,902
J. F. Comee, Missoula, Mont	2,000		
Spring Brook and Lakes, Omaha, Nebr			5,000
Spring Brook, East Grafton, N. H		20,000	
Christine Lake, Stark, N. H		9,975	
Merrimac County Fish and Game League, Concord, N. H		25,000	
State Fish Commission, Ashland, N. H	25,000		
A. M. Bigelow, Branchville, N. J	20,000		
Wm. Libbey, Princeton, N. J	300		
Charlotte Creek, Oneonta, N. Y		4,516	
Otego Creek, Oneonta, N. Y		4,516	
Crandall Brook, Greene, N. Y		4,516	
Tioughnioga River, De Ruyter, N. Y		4,516	
Big Brook, Adams Center, N. Y		4,516	
Montfreddy Brook, Syracuse, N. Y		4,516	
Shinglekill Creek, Cairo, N. Y		6,016	
Springbrook, Heartsdale, N. Y		6,016	
Cooper Brook, Peckskill, N. Y		3,668	
Moyer Creek, Frankfort, N. Y		4,516	
Trout Brook, Dexter, N. Y		4,516	
Horseshoe Pond, Horseshoe Pond, N. Y		4,516	
Little Moose River, Malone, N. Y		25,000	
Applicants in New York		2,808	
Brushy Fork of Licking River, Newark, Ohio		5,000	
Mad River, West Liberty, Ohio		4,000	
Mac-a-chee Run, West Liberty, Ohio		4,000	
North Branch of Owl Creek, Fredericktown, Ohio		5,000	

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Brook trout—Continued.			
Applicants in Ohio		11,000	
Strannahan Brothers, Hiram Station, Ohio	2,000		
Bear Creek, Medford, Oreg			2,300
Pine Creek, Hood River, Oreg			2,000
Panther Creek, Carlton, Oreg			2,000
Applicants in Pennsylvania			1,000
Pine, Spruce, and Baker runs, near Snowshoe, Pa		5,000	
Cockampany Brook, Wood River Junction, R. I		10,000	
Woods Lake, Rapid City, S. Dak			3,000
Applicants in South Dakota		21,000	3,500
Parley Canyon, Salt Lake City, Utah			5,000
Silver Islet Lakes, Park City, Utah			5,000
Applicants in Utah		5,000	2,000
State Fish Commission, Salt Lake City, Utah		15,000	
Grant Hampton, Salt Lake City, Utah	10,000		
Joseph H. Tuck, Salt Lake City, Utah	5,000		
L. C. Miller, Salt Lake City, Utah	5,000		
Edward McGurrin, Salt Lake City, Utah	5,000		
A. T. Godbe, Salt Lake City, Utah	5,000		
W. E. Miller, Salt Lake City, Utah	5,000		
J. H. Lundy, Salt Lake City, Utah	10,000		
George Manning, Salt Lake City, Utah	10,000		
G. J. Lund, Sugar Loaf, Utah	5,000		
Caledonia Club Pond, St. Johnsbury, Vt		25,000	
Tucker Brook, Woodstock, Vt		10,000	
Pico Pond, Sherburne, Vt		48,850	
Holland Pond, East Holland, Vt		10,000	
Griffith Pond, Danby, Vt		9,970	
Fairbanks Pond, St. Johnsbury, Vt		10,000	
Caspian Lake, Greensboro, Vt		49,910	
Darling Pond, Groton, Vt		100,000	
Spring Brook, Morrisville, Vt		10,000	
Lake Mitchell, Sharon, Vt		9,970	
Sleeper River, St. Johnsbury, Vt		30,000	
Applicants in Vermont		15,000	
Hon. T. N. Vail, Lyndonville, Vt	10,000		
State Fish Commission, Colebrook, N. H	10,000		
Caldwell and Little Spokane creeks, Spokane, Wash			4,000
Lake, New Whatcom, Wash			3,000
Applicant at Orilla, Wash			4,000
F. H. Cook, Spokane, Wash	25,000		
North Branch of Oconto River, Lakewood, Wis		5,000	
Black Oak Lake, State Line, Wis		5,000	
Plover River, Wausau, Wis		5,000	
Applicants in Wisconsin		2,000	
Dome Lake, Sheridan, Wyo			5,000
E. A. Schroder, Silesia, Austria	10,000		
Wm. Burgess & Co., Malvern Wells, England	10,000		
Swiss Government, Switzerland	25,000		
Total	319,300	1,863,798	161,391
Lake trout:			
State Fish Commission, Windsor Locks, Conn	300,000		
Spring Pond, Lanier Heights, D. C		1,000	
Geo. W. Rea, Arangee, Idaho	10,000		
Hudson Lake, South Bend, Ind		30,000	
Clear Lake, Clear Lake, Iowa		100,000	
Storm Lake, Storm Lake, Iowa		100,000	
Spirit Lake, Spirit Lake, Iowa		96,652	
Lake Okoboji, Spirit Lake, Iowa		92,652	
Silver Lake, Lake Park, Iowa		41,696	
Applicants in Iowa		10,000	
State Fish Commission, Enfield, Me	75,000		
Rocky Pond, Otis, Me		15,000	
Phillips Pond, Dedham, Me		30,000	
Applicants in Maine		10,000	
Green Lake, Ellsworth, Me		998	
State Fish Commission, Winchester, Mass	100,000		
Round Lake, Hanover, Mich		10,000	
Lake Huron, Alpena, Mich		29,800	
Lake Huron, off Thunder Bay Island, Mich		740,000	
Lake Huron, off Sugar Island, Mich		350,000	
Lake Michigan, Charlevoix, Mich		738,875	
Lake Michigan, Manistique, Mich		400,000	
Pine Lake, Charlevoix, Mich		408,875	
Twin Lakes, West Harrisonville, Mich		8,800	
Loon Lake, Hale Lake, Mich		8,900	
Crooked Lake, Lake George, Mich		10,000	
Little Star Lake, Baldwin, Mich		2,700	
Putnam Lake, Baldwin, Mich		7,700	
Bray Lake, Baldwin, Mich		2,600	
Straits of Mackinac, Mackinaw City, Mich		600,000	

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Lake trout—Continued.			
Straits of Mackinac, Cheboygan, Mich		400,000	
Long Lake, near Alpena, Mich		5,000	
Lake Superior, Grand Marais, Mich		400,000	
Lake Superior, Long Point, Mich		120,000	
Lake Superior, Washington Harbor, Mich		120,000	
Lake Superior, Fisherman's Home, Mich		120,000	
Lake Superior, off Wright Island, Mich		120,000	
Lake Superior, Rock Harbor, Mich		120,000	
Lake Superior, Chippewa Harbor, Mich		120,000	
Lake Superior, off Fish Island, Mich		120,000	
Lake Superior, Tobin Harbor, Mich		240,000	
Lake Superior, Todds Harbor, Mich		500,000	
Lake Superior, Ontonagon, Mich		23,000	
Crooked Lake, Lake Station, Mich		5,000	
Hamlin Lake, Baldwin, Mich		3,500	
Townsend Lake, Baldwin, Mich		6,500	
Mench Lake, Baldwin, Mich		7,000	
Cashren Lake, Baldwin, Mich		400,000	
St. Mary Lake, Sault Ste. Marie, Mich		25,000	
Black Bear Lake, Carlton, Minn		240,000	
Lake Superior, Chicago Bay, Minn		240,000	
Lake Superior, Grand Portage, Minn		240,000	
Lake Superior, Grand Marais, Minn		240,000	
Lake Superior, Poplar River, Minn		240,000	
Lake Superior, Beaver Bay, Minn		240,000	
Lake Superior, Two Harbors, Minn		240,000	
Lake Superior, French River, Minn		8,000	
Lake Superior, Duluth, Minn		114,481	
Wilson Bay, near Cape Vincent, N. Y		62,700	
Lake Ontario, off Cape Vincent, N. Y		805,150	
Lake Ontario, off Grenadier Island, N. Y		18,640	
Lake Oneida, Sylvan Beach, N. Y	200,000		
Henry Davidson, Old Forge, N. Y		908,800	
Lake Erie, Put-in Bay, Ohio		8,000	
Queens River, Kingston, R. I		20,000	
Lake Hendrick, White, S. Dak		8,000	
Applicants at Kimball, S. Dak		4,800	
Derby Pond, Derby, Vt		5,000	
Derby Pond, Newport, Vt		5,000	
Salem Pond, Derby, Vt		4,000	
Lake Dunmore, Salisbury, Vt	200,000		
State Fish Commission, Roxbury, Vt	100,000		
State Fish Commission, Colebrook, N. H		350,000	
Lake Michigan, Sheboygan, Wis		240,000	
Lake Superior, Bark Point, Wis		240,000	
Lake Superior, Sand Island, Wis		240,000	
Lake Superior, Raspberry Bay, Wis		240,000	
Lake Superior, Oak Island, Wis		480,000	
Lake Superior, Magdelona Island, Wis		17,250	
Lake Superior, near Lizard Island, Canada		240,000	
Lake Superior, Port Arthur, Canada	100,000		
Swiss Government, Switzerland			
Total	1,085,000	12,521,219	
Scotch sea trout:			
Alamoosook Lake, Orland, Me			1,489
New England Sportmen's Association, Boston, Mass			100
Total			1,589
Yellow-fin trout:			
Lower Twin Lakes, in Lake County, Colo		7,500	
Golden trout:			
Tributaries of Great Brook, Otis, Me		20,000	
Alligator Lake, Ellsworth Falls, Me		7,000	
Holbrook Pond, Holden, Me		7,000	
Branch Pond, Dedham, Me		20,000	
Flood Pond, Otis, Me		18,144	
State Fish Commission, Monmouth, Me	10,000		
State Fish Commission, Auburn, Me		7,000	
Total	10,000	79,144	
Grayling:			
Elk Creek, near Red Rock Lake, Mont		1,500,000	
Whitefish:			
Lake Huron, near Can Buoy, Mich		2,000,000	
Clear Lake, Valentine, Mich		500,000	
Lake Huron, near Thunder Bay Island, Mich		1,600,000	
Lake Huron, near Scarecrow Island, Mich		2,000,000	
Lake Huron, near Sugar Island, Mich		2,000,000	

Details of distribution—Continued.

Species and disposition.	Eggs.	Fry and fingerlings.	Adults and yearlings.
Whitefish—Continued.			
Lake Superior, Grace Harbor, Mich		98,000	
State Fish Commission, Ashland, N. H	200,000		
Lake Erie, near Put-in Bay, Ohio		56,990,000	
Lake Erie, Port Clinton, Ohio		17,720,000	
Lake Erie, Ottawa City, Ohio		5,580,000	
Total	200,000	88,488,000	
Pike perch:			
St. Lawrence River, near Cape Vincent, N. Y		9,243,750	
Raquette River, Potsdam, N. Y		800,000	
Lake Erie, Put-in Bay, Ohio		60,790,000	
Lake Erie, Port Clinton, Ohio		10,320,000	
Total		81,153,750	
Lake herring:			
Lake Erie, Put-in Bay, Ohio		15,050,000	
Lake Erie, Port Clinton, Ohio		3,920,000	
Total		18,970,000	

Species and disposition.	Adults and yearlings.
Black bass, large-mouth:	
Clear Creek, Winslow, Ariz	200
Reservoir, Tucson, Ariz	100
Woodruff Fish Lake, Holbrook, Ariz	100
Applicants in Arizona	250
Ouachita River, Lawrence, Ark	200
Ouachita River, Arkadelphia, Ark	200
Clear Lake, Mayflower, Ark	200
Silver Springs Mill Pond, Rogers, Ark	200
Potash Sulphur Springs, Lawrence, Ark	100
Saline River, Benton, Ark	200
Applicants in Arkansas	1,150
Lake Maria, Cuchara Junction, Colo	300
Applicants in Las Animas, Colo	100
Little River, Seymour, Conn	200
Brandywine Lake, Wilmington, Del	400
Fish Club Lake, Carlyle, Ill	100
Lake Zurich, Barrington, Ill	250
Mill Pond, Charleston, Ill	100
Vermilion River, Danville, Ill	450
Crystal Springs Lake, Jacksonville, Ill	100
Illinois Central R. R. Co.'s Pond, Monee, Ill	150
Le Claire Lake, Edwardsville, Ill	100
Channel Lake, Antioch, Ill	50
Kishwaukee River, Belvedere, Ill	100
Des Plaines River, Des Plaines, Ill	100
Woodley Lake, Woodbury, Ill	50
Applicants in Illinois	475
Eagle Lake, Warsaw, Ind	50
Kent Pond, Kentland, Ind	250
Mill Pond, Kingsbury, Ind	300
Indian Creek, Bossert, Ind	25
Mill Pond, Kingsland, Ind	195
Salt Creek, Bedford, Ind	75
White River, Tunnelton, Ind	25
White River, Bedford, Ind	25
Guthrie Creek, Bedford, Ind	25
Leatherwood Creek, Bedford, Ind	50
Buck Creek, Fort Ritner, Ind	25
Waterworks Lake, Booneville, Ind	25
Pine Creek, Walkerton, Ind	300
Pretty Lake, Plymouth, Ind	300
Eagle Lake, Eagle Lake, Ind	295
Cedar Lake, Cedar Lake, Ind	300
Lake James, Angola, Ind	480
Upper Salt Creek, Bedford, Ind	25
Falling Run Creek, New Albany, Ind	50
Furgason Lake, Knightstown, Ind	200
Sackritter, Kendallville, Ind	300
Applicants in Indiana	1,095
Applicants in Indian Territory	400
Iowa River, Iowa City, Iowa	100
Applicants in Iowa	100

Species and disposition.	Adults and yearlings.
Black bass, large-mouth—Continued.	
Applicants at Vinton, Iowa	100
Arkansas River, Great Bend, Kans	100
Eureka Lake, Manhattan, Kans	82
Carmichal Lake, Dodge City, Kans	100
Crystal Lake, Leavenworth, Kans	50
Forest Park Lake, Atchison, Kans	60
Valley View Lake, Lawrence, Kans	49
McDowell Creek, Manhattan, Kans	70
Forest Lake, Bonner Springs, Kans	35
Elmwood Lake, Bonner Springs, Kans	35
Buckner Creek, Jetmore, Kans	700
Pawnee Creek, Burdett, Kans	150
Lake Chanute, Olathe, Kans	25
Deer Creek, Atchison, Kans	30
Applicants in Kansas	1,555
Lake Gabriel, Holt, Ky	50
Little River, Hopkinsville, Ky	300
Dick River, Danville, Ky	50
Natural Bridge Lake, Natural Bridge, Ky	80
Nolin Creek, Hodgensville, Ky	50
Lake Ellerslie, Lexington, Ky	100
Lover's Lake, Hardenburg, Ky	50
Waterworks Reservoir, Junction City, Ky	50
Stony Creek, Paris, Ky	50
Rockbridge Lake, Lawrenceburg, Ky	50
Crystal Lake, Ryland Station, Ky	50
Illinois Lake, Paducah, Ky	500
Fennessy Lake, Culvertson Station, Ky	75
Applicants in Kentucky	480
Duck Pond, Crownsville, Md	100
Gunpowder River, Parkton, Md	200
Gunpowder River, Alesia, Md	200
Patuxent River, Laurel, Md	200
George Run, Parkton, Md	200
Keeney's Mill Pond, Freeland, Md	200
Little and Big Youghiogheny River, Oakland, Md	500
Potomac River, Woodmont, Md	1,200
Rock Creek, Kensington, Md	670
State Fish Commission, Baltimore, Md	6
Applicants in Maryland	250
Scargo Lake, Yarmouth, Mass	200
Elbow Pond, Buzzards Bay, Mass	430
New England Sportsmen's Association, Boston, Mass	10
Black River, Cheboygan, Mich	100
Big Lake, Evart, Mich	100
Pine Lake, Detroit, Mich	100
Hamlin Lake, Luddington, Mich	50
Pleasant Lake, Leslie, Mich	400
Round Lake, Hanover, Mich	400

Details of distribution—Continued.

Species and disposition.	Adults and yearlings.
Black bass, large-mouth—Continued.	
Cass River, Marlette, Mich	100
Base Lake, Dexter, Mich	150
Applicants at Ypsilanti, Mich	150
Clear Lake, Waseca, Minn	300
Silver Lake, Battle Lake, Minn	100
Lake Tetonka, Waterville, Minn	300
Caribou Lake, Duluth, Minn	50
Twin Lakes, Kansas City, Mo	50
Branch of Wilson Creek, Springfield, Mo	300
Sac and James rivers, Springfield, Mo	300
Silver Lake, Cedar Gap, Mo	100
Reservoir, Moberly, Mo	200
Five Mile Creek, Joplin, Mo,	100
Valle Lake, Ste. Genevieve, Mo	500
Dry Fork Creek, Carthage, Mo	200
White River, Forsyth, Mo	185
Applicants in Missouri	700
Applicants in Nebraska	130
Lake Hopatcong, Mount Arlington, N. J	200
C. A. Shriver, State fish commissioner, Jersey City, N. J	2,000
Applicants in New Jersey	150
Paloduro Canyon Creek, Salt Lake, N. Mex	200
Applicants in New Mexico	300
Greenwood Lake, Orange Co., N. Y	800
Summit Ave. Lake, Greensboro, N. C	150
Chockoyotte Creek, Weldon, N. C	100
Poplar Lake, Reidsville, N. C	150
Rocky Creek, Statesville, N. C	100
Applicants at Asheville, N. C	100
Square Butte Creek, Mandan, N. Dak	250
Devil Lake, Devil Lake, N. Dak	260
Spirit Wood Lake, Jamestown, N. Dak	800
Park Lake, Mayville, N. Dak	100
Lake Metigoshe, Bottineau, N. Dak	180
Willow Lake, Rolla, N. Dak	75
Lake Irvine, Church Ferry, N. Dak	185
Rise Lake, Minot, N. Dak	100
Minnehaha Lake, Rolla, N. Dak	100
Mineral Springs, Rolla, N. Dak	50
Sheyenne River, Valley City, N. Dak	300
Long Lake, Bismarck, N. Dak	100
Church Spring, Inkster, N. Dak	50
Stump Lake, Lakota, N. Dak	260
Applicants at Davenport, N. Dak	200
Cliff Lake, Springfield, Ohio	100
Lake Idlewild, Kenton, Ohio	100
Tuscarawas River, Zoar, Ohio	150
Rosemoor Lake, Oxford, Ohio	50
Stillwater Creek, Troy, Ohio	100
Crystal Lake, Ravenna, Ohio	100
Olantangy River, Mt. Gilead, Ohio	150
Lake Epworth, Bethesda, Ohio	50
Hocking River, Athens, Ohio	100
Clear Fork Creek, Bellville, Ohio	100
Congress Lake, Congress Lake, Ohio	150
Wyoga Lake, Cuyahoga Falls, Ohio	100
Applicants in Ohio	986
Spring Branch, North Enid, Okla	100
Cheadle Creek, Guthrie, Okla	100
Mosquito Creek, Higgins, Okla	100
Canadian River, Shawnee, Okla	100
Spring Lake, Woodward, Okla	100
Applicants in Oklahoma	2,000
York Pond, Kingston, R. I	500
Charles W. Willard, State fish commissioner, Westerly, R. I	500
Maschang Pond, Westerly, R. I	300
Sheldon Reserve Pond, Sheldon, S. C	100
Castle Hill Reserve Pond, Yemassee, S. C	100
Applicants in South Carolina	300
Wautauga River, Johnson City, Tenn	100
French Broad River, Del Rio, Tenn	100
Spring Lake, Templeton, Tenn	50
Sulphur Fork Creek, Cedar Hill, Tenn	450
Black bass, large-mouth—Continued.	
Yellow Creek, Cave Mills, Tenn	100
Big Pigeon River, Newport, Tenn	100
Hill's Creek, McMinnville, Tenn	100
Elk River, Fayetteville, Tenn	100
Little Pigeon River, Knoxville, Tenn	200
Cane Creek, Fayetteville, Tenn	100
Corley Creek, Mae, Tenn	100
Mill Pond, Ætna, Tenn	100
Spring Brook, Doyal, Tenn	70
Chickamauga Lake, Chattanooga, Tenn	100
Green Lake, Chattanooga, Tenn	100
Short Creek and Pigeon Roost Creek, Cookeville, Tenn	200
Clear Fork River, Rugby Road, Tenn	100
Big Spring Creek, Church Grove, Tenn	100
Little Sequachee River, Sequachee, Tenn	100
Applicants in Tennessee	396
Sweetwater Creek, Miami, Tex	500
Timber Lakes, Clarendon, Tex	100
Paloduro Creek, Amarillo, Tex	200
Comal Spring and River, New Braunfels, Tex	450
Groesbeck Creek, Quannah, Tex	50
Lee Creek, Miami, Tex	300
Ranner Springs, Buffalo, Tex	100
Lampasas River, Lampasas, Tex	400
Catfish Lake, Tyler, Tex	200
Chapman Lake, Fort Worth, Tex	150
Oakland Lake, Denton, Tex	200
Tucker Lake, Tyler, Tex	200
Lake Park Lake, Tyler, Tex	200
Sulphur Branch, Rockland, Tex	400
Reservoir, Tioga, Tex	150
Houston and Texas Central R. R. Pond, Bremond, Tex	367
Walton Lake, Granger, Tex	75
Concho River, San Angelo, Tex	250
Santa Clare Creek, Marion, Tex	200
Menger Creek, Boerne, Tex	100
Fossil Creek, Fort Worth, Tex	150
Hurst Lake, Fort Worth, Tex	250
Russell Creek, Miami, Tex	200
Spring Creek, San Angelo, Tex	200
Lake Como, Fort Worth, Tex	300
Trinity River, Fort Worth, Tex	550
Clear Creek, Fort Worth, Tex	100
Turkey Creek, Cline, Tex	100
Sabinal River, Sabinal, Tex	200
Chaptico Lake, Marshall, Tex	150
Sue Belle Lake, Marshall, Tex	150
Elmendorf Lake, San Antonio, Tex	150
Spivey Lake, Kerens, Tex	200
Fin and Feather Club's Lake, Dallas, Tex	150
San Felipe Creek, Del Rio, Tex	100
San Antonio River, Floresville, Tex	300
Lake Louise, Brenham, Tex	100
Leona and Nueces rivers, Uvalde, Tex	200
Bow Spring Lake, West, Tex	175
Lake McDonald, Austin, Tex	600
Richland Creek, Brownwood, Tex	200
Tidoroni Creek, Alice, Tex	150
Mill Pond, Dallas, Tex	100
San Antonio River, San Antonio, Tex	225
Houston and Texas Central R. R. Co. Pond, Allen, Tex	166
Houston and Texas Central R. R. Co. Pond, Richland, Tex	167
San Miguel Creek, Pearsall, Tex	75
Reservoir, Banquette, Tex	150
Guadaloupe River, Kerrville, Tex	150
Hines Springs, Buffalo, Tex	100
Llano River, Llano, Tex	150
Cleveland Lake, Sugarland, Tex	75
Comanche Creek, Marathon, Tex	100
Barton Creek, Clarendon, Tex	350

Details of distribution—Continued.

Species and disposition.	Adults and yearlings.
Black bass, large-mouth—Continued.	
Medina River, Medina, Tex	150
Terra Blanco Creek, Amarillo, Tex	100
Amarillo Creek, Amarillo, Tex	150
Spring Creek, Amarillo, Tex	100
Alamositas Creek, Channing, Tex	150
Trinity River Lakes, Palestine, Tex	300
Cheyenne Creek, Channing, Tex	100
Rita Blanco Creek, Channing, Tex	150
Clear Creek, Hempstead, Tex	150
Cedar Lake, Palestine, Tex	150
Buffalo Springs Creek, Texline, Tex	150
Dripping Springs Creek, Channing, Tex	150
Guadaloupe River, Comfort, Tex	300
Majores Creek, Channing, Tex	150
Truxillo Creek, Channing, Tex	150
Mill Pond, Llano, Tex	150
Turkey Creek, Taylor, Tex	300
Groesbeck Creek, Quannah, Tex	100
Old River Lake, Chapel Hill, Tex	200
Pridham Lake, Cuero, Tex	100
Little Rove Creek, Higgins, Tex	150
Ocean Lake, Wills Point, Tex	100
Goose Lake, Wills Point, Tex	100
Kelley Creek, Yoakum, Tex	200
Palestine Club's Lake, Palestine, Tex	100
Fort Worth and Denver City R. R. Co. Pond, Bellevue, Tex	200
Fort Worth and Denver City R. R. Co. Pond, Quannah, Tex	200
Fort Worth and Denver City R. R. Co. Pond, Wichita Falls, Tex	200
Elm Creek, Gainesville, Tex	100
Applicants in Texas	14,730
Sabin Lake, East Calais, Vt	450
Rappahannock River, Fredericksburg, Va	300
Linnwood Lake, Pulaski City, Va	100
Applicants in Virginia	800
West Fork of Monongahela River, Clarksburg, W. Va	300
Severus Lake, Minong, Wis	250
Powaukee Lake, Waukesha, Wis	300
Elbow Lake, Amberg, Wis	250
Wisconsin Central R. R. Co. Pond, Waupaca, Wis	1,000
C. Grilsenbeck, Monterey, Mexico	300
Total	76,064
Black bass, small-mouth:	
Potomac River, Woodmont, Md	300
Elbow Lake, Buzzard Bay, Mass	30
Waterworks Reservoir, Norwalk, Ohio	20
C. W. Willard, State fish commissioner, Westerly, R. I	460
Applicants in Tennessee	65
Shenandoah River, Overall, Va	1,000
Total	1,884
Crappie:	
Applicant at Wilmington, Del	100
Applicants in Illinois	375
Lake Marie, Antioch, Ill	100
Indian Creek, Bossert, Ind	50
Salt Creek, Bedford, Ind	100
White River, Tunnelton, Ind	50
Guthrie Creek, Bedford, Ind	50
Leatherwood Creek, Bedford, Ind	125
Back Creek, Fort Ritner, Ind	50
Waterworks Lake, Booneville, Ind	50
White River, Bedford, Ind	50
Upper Salt Creek, Bedford, Ind	50
Applicants in Indiana	125
Iowa River, Iowa City, Iowa	100
Applicant at Vinton, Iowa	100
Crystal Lake, Leavenworth, Kans	25
Eureka Lake, Manhattan, Kans	30
Alfalfa Lake, Wichita, Kans	65

Species and disposition.	Adults and yearlings.
Crappie—Continued.	
Lake Chanute, Olathe, Kans	25
Applicants in Kansas	70
Fennessey Lake, Culvertson Station, Ky	100
Applicants in Kentucky	450
Amity Lake, Duluth, Minn	300
Applicant at Kansas City, Mo	25
Poplar Lake, Reidsville, N. C	100
Square Butte Creek, Mandan, N. Dak	45
Willow Lake, Rolla, N. Dak	25
Lake Irvine, Church Ferry, N. Dak	40
Applicant at Davenport, N. Dak	50
Sheldon Reserve Pond, Sheldon, S. C	100
Applicant at Bennettsville, S. C	150
Dutch River, Columbus, Tenn	100
Applicants in Tennessee	72
San Marcos River, San Marcos, Tex	50
Meadowbrook Creek, Charlottesville, Va	72
Total	3,369
Sunfish:	
Shaker Lake, Cleveland, Ohio	69
Rock bass:	
Clear Creek, Winslow, Ariz	200
Reservoir, Tucson, Ariz	200
Applicants in Arkansas	1,600
Vanno Lake, Wagoner, Ind. T	200
Applicants in Indian Territory	480
Pawnee River, Larned, Kans	159
Applicants in Kansas	1,841
Lake Ellerslie, Lexington, Ky	221
Applicant in Maryland	200
White River, Forsythe, Mo	500
Applicants in Missouri	300
Reservoir, Elsie, Nebr	200
Lake Avalon, Eddy, N. Mex	200
Chockoyotte Creek, Weldon, N. C	115
Cross Creek, Fayetteville, N. C	100
Beaver Creek, Fayetteville, N. C	100
Applicants in North Carolina	1,400
Chippewa Lake, Chippewa Lake, Ohio	300
Olantangy River, Mount Gilead, Ohio	125
Shaker Lake, Cleveland, Ohio	208
Waterworks Reserv'r, Norwalk, Ohio	57
Applicants in Ohio	250
Spring Branch, North Enid, Okla	200
Divers Lake, North Enid, Okla	200
Ivanhoe Lake, Shattuck, Okla	200
Spring Creek, Sand Creek, Okla	200
Meers Creek, Mangum, Okla	200
Applicants in Oklahoma	3,800
Conestoga Creek, Reading, Pa	100
Lake Popononing, Bethlehem, Pa	100
Jacobs Creek, Connellsville, Pa	100
Conococheague Creek, Mercersburg, Pa	100
Middle Creek, Selinsgrove, Pa	100
Middle Creek, Middleburg, Pa	100
Ridley Creek, Nudia, Pa	100
Conococheague Creek, Chambersburg, Pa	400
Schuylkill River, Norristown, Pa	200
Perkiomen Creek, Norristown, Pa	100
Lake Rowena, Cresson, Pa	100
Witmer Run, Berwindale, Pa	100
Clover Creek, Johnstown, Pa	60
Penn Line Creek, Penn Line, Pa	100
Applicants in Pennsylvania	550
Brook Pond, Rockhill, S. C	100
Applicants in South Carolina	400
Shell Creek, Elizabethton, Tenn	100
Yellow Creek, Cave Mills, Tenn	100
Little River, Knoxville, Tenn	150
Crooked Creek, Notime, Tenn	200
Applicants in Tennessee	886
Guadaloupe River, New Braunfels, Tex	200
Elmendorf Lake, San Antonio, Tex	350

Details of distribution—Continued.

Species and disposition.	Adults and yearlings.
Rock bass—Continued.	
Balcomes Creek, San Antonio, Tex	200
Llano River, Llano, Tex	200
Guadalupe River, Ganahl, Tex	200
Lake Julia, Houston, Tex	200
Applicants in Texas	2,350
Buffalo Lick Run, Winchester, Va	100
Carter Run, Warrenton, Va	100
Applicants in Virginia	1,150
Applicants in West Virginia	300
Total	23,352
Strawberry bass:	
Clear Creek, Winslow, Ariz	100
Woodruff Fish Lake, Holbrook, Ariz	200
Applicant at Wilcox, Ariz	100
Ouachita River, Lawrence, Ark	200
Ouachita River, Arkadelphia, Ark	500
Clear Lake, Mayflower, Ark	300
Potash Sulphur Springs, Lawrence, Ark	200

Species and disposition.	Adults and yearlings.
Strawberry bass—Continued.	
Saline River, Benton, Ark	400
Applicant at Ozark, Ark	200
Buckhorn Lake, Wynnewood, Ind. T	500
Applicant at Ardmore, Ind. T	200
Applicants at Sewell, Iowa	100
Applicant at Upton, Ky	242
Sac and James rivers, Springfield, Mo	300
Five-mile Creek, Joplin, Mo	100
Valle Lake, Ste. Genevieve, Mo	400
White River, Forsythe, Mo	500
Applicants in Nebraska	70
Lake Avalon, Eddy, N. Mex	500
Paloduro Canyon Creek, Salt Lake, N. Mex	300
Cliff Lake, Springfield, Ohio	25
Crystal Lake, *Ravenna, Ohio*	50
Applicant at Cincinnati, Ohio	25
Canadian River, Shawnee, Okla	200
Applicant at Woodward, Okla	200
Total	5,912

Species and disposition.	Fry.
Codfish:	
Massachusetts Bay, Gloucester	59,278,000
Vineyard Sound, near Robinson Hole, Mass	2,607,000
Vineyard Sound off—	
Cuttyhunk Island, Mass	8,961,000
Quicks Hole, Mass	13,760,000
Gay Head, Mass	32,575,000
Tarpaulin Cove, Mass	8,376,000
Atlantic coast waters—	
Gloucester, Mass	15,245,000
Rockport, Mass	17,035,000
Atlantic Ocean off—	
Vineyard light-ship, Mass	3,654,000
Gay Head, Mass	20,360,000
Vineyard Sound, off Cuttyhunk light, Mass	3,566,000
Buzzards Bay, near Robinson Hole, Mass	5,631,000
Cape Cod Bay, off Race Point light, Mass	3,782,000
Ipswich Bay, Rockport, Mass	5,149,000
Vineyard Sound, mouth of Woods Hole Harbor, Mass	33,000
Cape Cod Bay, Provincetown, Mass	2,558,000
Total	202,570,000
Pollock:	
Atlantic coast waters, Gloucester, Mass	978,000
Massachusetts Bay, Gloucester, Mass	3,477,000
Total	4,455,000
Flatfish:	
Woods Hole Harbor, Mass	33,364,000
Waquoit Bay, Waquoit, Mass	5,973,000
Total	39,337,000
Lobster:	
Gulf of Maine near—	
Damascove Island, Me	500,000
George Island, Me	500,000
Wheeler Bay, Me	500,000
Western Point, Richmond Island, Me	600,000
Cape Elizabeth, Me	4,000,000
Northwest shore of Wood Island	600,000

Species and disposition.	Fry.
Lobster—Continued.	
Gulf of Maine near—	
Southeast shore, Andrews Island, Me	1,000,000
Greens Landing, Me	1,000,000
Gulf of Maine off—	
Swan Island, Me	200,000
Cranberry Island, Me	200,000
Gulf of Maine, north point of Matinicus Island, Me	1,000,000
Kittery Harbor, Kittery Point, Me	3,000,000
Casco Bay, between Hope and Crotch Islands, Me	1,200,000
Johns Bay, near Johns Island, Me	1,500,000
Rockland Bay, near Seal Ledge, Me	500,000
Maine coast waters, York Beach	1,200,000
Casco Bay, off Bailey Island, Me	1,200,000
Prospect Harbor, Me	200,000
Jonesport Harbor, Jonesport, Me	200,000
Cutler Harbor, Cutler, Me	200,000
Casco Bay, Small Point Harbor, Me	3,000,000
Massachusetts Bay—	
Gloucester, Mass	12,356,000
Marblehead, Mass	950,000
Beverly, Mass	595,000
Magnolia, Mass	4,125,000
Manchester, Mass	6,515,000
Massachusetts coast waters—	
Rockport, Mass	7,800,000
Gloucester, Mass	3,325,000
Woods Hole Harbor, Mass	2,095,000
Vineyard Sound, Gosnold, Mass	8,627,000
Vineyard Sound, Woods Hole, Mass	8,459,000
Vineyard Sound, Gay Head, Mass	415,000
Waquoit Bay, Waquoit, Mass	208,000
Gloucester Harbor, Gloucester, Mass	4,751,000
Buzzards Bay, Gosnold, Mass	5,072,000
Buzzards Bay, Woods Hole, Mass	612,000
Buzzards Bay, New Bedford, Mass	512,000
Buzzards Bay, Quissett, Mass	1,672,000
Ipswich Bay, Lanesville, Mass	1,080,000
Boston Harbor, Boston, Mass	900,000
Atlantic Ocean, off Vineyard Sound light-ship, Mass	1,265,000
Portsmouth Harbor, New Castle, N. H	1,200,000
Block Island Sound, near Block Island, R. I	1,200,000
Total	95,234,000

NOTE.—During the fiscal year 1898, 566 tautog, 271 lobster, and 162 blue crab were planted in the Pacific Ocean, near Farallone Islands, in the State of California.