REPORT ON THE PROPAGATION AND DISTRIBUTION OF FOOD-FISHES.

By S. G. Worth, *Acting Assistant in Charge.*

INTRODUCTION.

In the Report proper of the Commissioner, pp. 6 and 14, reference may be found concerning the appointment of Dr. Tarleton H. Bean as assistant in charge of the Division of Fish-Culture, and also Dr. Bean's subsequent appointment as United States Fish Commission representative at the World's Columbian Exposition, Chicago, Ill. The performance of duties incident to the Exposition caused Dr. Bean to be absent from the Washington office after January 15.

Duties devolving upon the acting assistant, additional to those of the office of the Division of Fish-Culture, consisted in the installation of shad-hatching operations at Battery Island Station, the supervision of Central and Bryan Point stations, the preparation of artificial fish eggs for illustrating the hatching of eggs of a semi-buoyant and floating nature at the World's Fair, Chicago, the adaptation of a baggage car for transporting fishes in water oxygenized on a new plan, namely, with air circulation, and assisting the Commissioner in preparing for and conducting his experiments for solving in advance the value of salt water wholly artificial in character as the medium for exhibiting marine animals and plants in a live state at Chicago. There was also large expenditure of time and individual labor as a member of the civil service board of examiners of the Fish Commission.

STATION OPERATIONS.

The stations operated during the year were:

Schoodic Station, Maine.
Craig Brook Station, Maine.
Green Lake Station, Maine.
Gloucester Station, Massachusetts.
Woods Hole Station, Massachusetts.
Delaware River Station (steamer *Fish Hawk*).
Battery Island Station, Maryland.
Bryan Point Station, Maryland.
Central Station, Washington, D. C.
Fish Ponds, Washington, D. C.
Wytheville Station, Virginia.
Put-in Bay Station, Ohio.
Northville Station, Michigan.
Alpena Station, Michigan.
Duluth Station, Minnesota.
Quincy Station, Illinois.
Neosho Station, Missouri.
Leadville Station, Colorado.
Baird Station, California.
Fort Gaston Station, California.
Clackamas Station, Oregon.

SCHOODIC STATION, MAINE (CHARLES G. ATKINS, SUPERINTENDENT).

The fiscal year opened with 50,000 landlocked salmon in the rearing-troughs, the hatching of the April preceding. The losses amounted in July to 106 and in August to 1,346. Late in August about 48,000 were liberated in Grand Lake and its outlet. In September all property was stored, the services of employees discontinued, and subsequently such part of the apparatus as was deemed of value transferred to the Craig Brook Station, work being permanently stopped, and further operations with the landlocked salmon conducted at Green Lake Station.

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

Some minor but important constructions during the year made this station almost perfect for the hatching and rearing of salmonidæ.

Atlantic salmon.—The most important departure in fish-cultural methods was in the disposition, widely apart on the lawn, of stands of rearing-troughs fed by water of different origin, the object being to prevent the recurrence of a wholesale spread of disease like that of the preceding year, and, in the event of the reappearance of unfavorable symptoms, to determine, if practicable, the underlying cause and the measures favorable to its eradication. No unfavorable developments occurring, the seat of former attacks remained undiscovered.

The collection of eggs was again effected, in cooperation with the authorities of the State of Maine. There had been purchased in June, 1892, and confined in the inclosure at Dead Brook, 222 adult fish, of which number 170 were available in October and November, 108 being females. The result in eggs was 1,108,500, of which 1,025,000 were alive in February when division was made, the portion of the Maine commissioners being 565,000 and that of the United States 460,000; of these latter, there were shipped as follows:

Date	To whom shipped.	No. of eggs.
Jan. 25 1893..	E. B. Hodge, fish commissioner, Plymouth, N. H.	50,000
Jan. 25, 1893..	F. Mather, superintendent, Cold Spring Harbor, N. Y.	75,000
Feb. 16, 1893..	R. E. Follett, superintendent, Lime Rock, Conn	108,000
Feb. 19, 1893..	United States Fish Commission Station, Green Lake, Me	10,000

The remainder, 217,000, were applied to hatching and rearing. The Maine commissioners being desirous of devoting a portion of their quota of eggs to further stocking the Penobscot River, arrangements were effected for developing and hatching at the station as many of their stock as 200,000, they providing the additional labor and supplies requisite to meet the increased demands. These authorities subsequently donated 84,000 fry to the United States.

Forty-three salmon, resulting from eggs taken November, 1887, yielded in November, 1891, about 12,000 eggs, and in November, 1892, produced about 23,000 eggs. As the parent fish from the fry stage had been continuously held in fresh-water ponds of the station, thereby becoming

acclimated and successfully reproducing their kind, the experiment is not without interest. A portion of the 23,000 eggs perished and 10,000 were shipped to the Green Lake Station, those remaining being applied to hatching. The resulting fry, estimated at 5,000, were represented by 2,000 survivors June 30, 1893. Of the total of 2,010 surviving Atlantic salmon on hand as fingerlings June 30, 1892, from the hatching of 305,000 eggs in April of that year, 1,100 were from eggs of the acclimated parents, and of the 1,448 subsequently liberated in November, 696 were of this kind. At the date of the liberation referred to, as many as 500 were remaining as a reserve, but these were reduced to 156 by the following June.

Landlocked salmon.—From fish reared 9,800 eggs were taken in November, and from wild fish captured from Toddy Pond 4,200 were secured. It is believed that the spawning fish in Toddy Pond were the large ones liberated from the Craig Brook Station in the spring of 1892. Egg losses were rather large.

Brook trout.—Fourteen thousand eggs were taken from fish reared in station ponds. The hatching is shown in tabular statement.

Rainbow trout.—The thirty adult fish held in ponds were reared at the station, having been hatched in 1889 from eggs received from the Northville Station, Michigan. In the spring of this year they, for the first time, evinced a tendency to spawn, eggs being taken March 15 and 16 to the number of 10,000. The eggs were inferior, and during the year there were seventeen deaths among the brood stock.

The statement below, based on close estimates, represents eggs of various species employed in hatching, and shows the results up to a period when all except the rainbow trout were taking food:

Kind.	Number of eggs.	Results in fry.		
		Hatched.	May 31.	June 30.
Atlantic salmon	227,300	226,800	a 290,000	257,500
Atlantic salmon acclimatized	13,400	6,800	5,000	2,000
Landlocked salmon	14,000	11,900	11,000	7,000
Brook trout	13,600	13,300	10,000	9,000
Rainbow trout	10,100	2,000	1,900	1,000
Total	278,400	260,800	317,900	276,500

a Increase effected by presentation, about June 1, of 84,000 by the Maine authorities.

In July the growing of fly larvæ was resumed, these with chopped meats comprising the food of the fish. Later in the summer experimental trials were made in the capture of grasshoppers, to determine their relative cost and food value, natural food having so far been found most desirable.

Losses sustained in the preceding year, from the causes mentioned, among fishes to be subjected to rearing, were so great that the numbers remaining on hand at commencement of the year, July 1, 1892, were comparatively small, as follows: Atlantic salmon, 2,010; landlocked salmon, 19,538; brook trout, 39,531; whitefish, 442; total, 61,521. From these, distribution of 52,713 was made, as follows:

Kind.	Date.	Number.	Place.
Atlantic salmon	November, 1892	1,448	Alamoosook Lake.
Landlocked salmon	July, 1892	999	Commodore Club, Hartland, Me.
Do	October, 1892	8,256	Toddy Pond, Orland, Me.
Do	June, 1893	7,776	Do.
Brook trout	July, 1892	1,970	Commodore Club, Hartland, Me.
Do	October and November, 1892	27,564	Alamoosook Lake.
Do	January, 1893	3,000	Otter Creek, Proctor, Vt.
Do	February, 1893	500	John McDonald, Amherst, Me.
Do	March, 1893	1,200	Beaver Pond, Proctor, Vt.

Of older fishes of various kinds brought over, there were 433, in addition to 199 adult sea salmon purchased jointly with the Maine commissioners from the Penobscot River catch, the latter having been confined in the inclosure at Dead Brook to await maturing of their eggs in November of this fiscal year, when they were manipulated and returned to open waters. Besides 276,500 fish in process of rearing, shown in a preceding table, there were on hand at the end of the year 242 wild Atlantic salmon, purchased in June as prospective spawners, and also those species enumerated in the subjoined statement:

Kind.	Year when hatched.					
	1892.	1891.	1890.	1889.	1888.	1888 and 1889.
Atlantic salmon	156	.....	34	.....	33	.....
Landlocked salmon	.....	.....	29	.....	.....	26
Brook trout	14	.....	.....	28	.....	.....
Rainbow trout	.....	.....	.....	13	.....	.....
Loch Leven trout	.....	.....	49	.....	.....	.....
Swiss lake trout	.....	.....	29	.....	.....	.....
Scotch sea trout	.....	63	.....	.....	.....	.....
Von Behr trout	.....	47	.....	.....	.....	.....
Saibling	.....	.....	1	.....	.....	.....
Whitefish	1	.....	.....	.....	.....	.....
Total	171	110	142	41	33	26

Meteorological data of the year is presented in condensed form below. The water used at the hatching-house flows through a conduit having connection with the brook at a point above the sources of the springs. Pond B, referred to in table, being situated below the hatchery, receives a mixture of brook and spring water. It is a small pond, which, till May, 1893, accommodated the Atlantic salmon previously referred to as having been acclimated. The north stand of rearing-troughs, outdoor situation, is fed from above the hatchery, receiving commingled waters of brook and springs. Alamoosook Lake, a body of fresh water about 5 miles long, on the bank of which the station is located, became closed by ice formation December 12, and was not again open until May 1. On February 10 the ice measured 28½ inches, and was crossed by teams December 25 and April 8. Early in December exposed water conduits were protected by a covering of hay, boards, and evergreen brush, and toward the end of the month the two ice-houses were filled from the lake. The observations on which the table is based were made daily, at 7 a. m. and 2 p. m., omissions in June being incident to shutting off water for repairs:

Month.	Temperature, Fahrenheit.												Precipitation in inches.	
	Air.			Water.										
				Hatchery.			Outlet of Pond B.			Supply of north stand troughs				
	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Rain.	Snow.
July	91	53	70.8	74	58	67.4	72	55	63.5	67	54	59.8	1.6	.....
August	89	52	68.8	75	64	69.6	73	59	65.2	68	56	62.2	4.5	.....
September	73	42	60.2	68	58	64.3	67	54	62	65	54	61.3	4.8	.....
October	68	26	45.5	60	47	53.5	50	46	52.2	59	47	52.3	1.1	.....
November	61	18	37.2	48	38	43.8	52	39	44.5	52	40	45.2	4.2	.....
December	43	— 6	20.6	40	32.5	35	43	32.5	36.6	44	36	39	1.3	3.5
January	42	—12	13.1	36	32.5	33.2	39	32.5	34.7	40	35	36.4	2.6	7.5
February	42	— 8	17.4	35	32.5	33.1	38	32.5	34	40	34	36	1.5	32.6
March	48	— 4	27.6	37	32.5	34.4	42	32.5	36	42	34	37	1.2	2
April	59	18	38.6	46	35	38.7	49	34	40	50	34	40	.9	8
May	81	39	54.7	59	39	45.7	57	39	46	56	39	47.7	2.8	.....
June	84	52	65.6	.....	.....	.....	.....	.....	.....	64	50	58	2.6	.....

GREEN LAKE STATION, MAINE (H. H. BUCK AND SEYMOUR BOWER, SUPERINTENDENTS).

This station being new and incomplete, the year opened with improvements in progress. Mr. H. H. Buck was in charge until August 31, his resignation having been tendered in April, but remaining unacted upon owing to delay attending the selection of an efficient successor. He was followed by Seymour Bower, who was appointed from the foremanship of the Put-in-Bay Station, Ohio, and arrived for duty September 12. Mr. Bower's services, however, being solicited by the commissioners of Michigan, he tendered his resignation May 8, in order to accept the superintendency of the fish-cultural operations of that State. Owing to the inconvenience of providing a competent successor, Mr. Bower's services were retained until June 30. On his departure affairs were temporarily put under direction of the foreman, W. H. Munson.

Fry resulting from the April hatching and on hand at beginning of the fiscal year, by estimate, were as follows: Landlocked salmon, 60,000; Loch Leven trout, 16,000; Von Behr trout, 10,000; total, 86,000.

During July they underwent but little loss, but in August many deaths occurred. In September active measures were instituted with a view to checking the mortality. The changes were in the nature of increasing the depth of water in the rearing-troughs from 2½ to 4 inches, daily cleaning with scrub brushes and salt, increasing the flow of water through troughs, and more systematic and careful feeding. The numbers, by count, in December were but 4,903 landlocked salmon, 1,805 Loch Leven trout, and 1,252 Von Behr trout. Subsequent losses were trifling, there being but 14 dead removed in the four months following. The maximum water temperature in July was 82° F., in August 70°, and in September 68°. During the four months' period just referred to there were no deaths among the 3,800 landlocked salmon hatched in April, 1891, held in the reservoirs. On May 5 the fish of April, 1892, were again counted and transferred from rearing-ponds to new earth ponds, the numbers being, landlocked salmon, 4,656; Loch Leven trout, 1,688; Von Behr trout, 1,042; total, 7,386.

In April there were shipped alive to the World's Fair by Car No. 3 100 of each kind of trout and 300 of the salmon; also, 200 of the salmon

of 1891. Other specimens sent consisted of 9 wild adult brook trout, 4 wild adult salmon, and a small collection of smelt from Green Lake. The only fish liberated, and these by accident, consisted of 500 of the younger salmon, which escaped into Green Lake November 16 through the misplacement of a screen. On December 14 there were 19 small German carp sent to the station by Dr. W. M. Haines, of Ellsworth, and liberated in Great Brook, tributary to Green Lake.

Landlocked salmon.—The salmon of Green Lake, averaging 6 pounds in weight, ordinarily spawn in the inflowing streams, but some pass through the outlet and lay their eggs below in the waters of Reed Branch, as was this year definitely proved. When the spawning period arrives during the seasons of drought, the affluents being low, the fish will not pass up, but remain in the lake. To induce them to ascend Great Brook at such times it is necessary to resort to artificial flushing, and there being facilities on the headwaters for accomplishing this, success has been attained. Mountainy, the uppermost pond, 5 miles distant, is used as the flushing reservoir, the system pursued consisting in opening gates about 2 p. m., creating a large flow throughout the night. The rainfall in September and October having been slight, there was by November 1 barely sufficient water for this purpose and the station proper. Great Brook was the only affluent affording adult fish, though in October many were seen jumping near the mouths of other inlets.

Egg collections being wholly dependent on wild fish, arrangements for capture were effected in September, at which time the slat traps in Great Brook were repaired, another obstruction being put in position at the discharge of Mann Brook. Two others were located at the lower end of the lake, one just inside, for the capture of outward-moving fish, and the other in Reed Brook, about a mile below, for the capture of fish ascending. Wire screens were, in November, placed in the gateways at the discharge of the lake to prevent fish escaping. Before the screens were inserted as many as 100 young salmon from 6 to 10 inches long were at one time seen below the dam.

The aggregate catch was 152, Great Brook furnishing 83 and the lake outlet trap 69. Of the captures at Great Brook trap, 53 were females; of those from the outlet of the lake, the females numbered 26. One salmon bearing "No. 2" tag, attached in 1890, was taken. The first capture, on September 27, consisted of two males and three females. On October 31 the first eggs of the season, 12,000 in number, were obtained. The largest success at the outlet of the lake was November 4, when 14 fish were taken, 8 of the 9 females affording 22,000 eggs of good quality. The most successful day was November 9, when 31,500 eggs were taken from fish held in the Great Brook traps. The last eggs were taken November 23, and the next day all parent fish were set free in the lake, the total of eggs for the season being 213,300. An inspection of the stream feeding Mountainy Pond was made in October, and also that connecting Mountainy and Rocky ponds in November, to determine the presence of available spawners, but no indications were found.

The eggs acquired were of superior quality, only 9,000 having been discarded by December 31, when the outlines of the embryos were clearly visible. It was anticipated that more than 200,000 would hatch, but on January 15 an unexpected death rate was encountered and its continuance for a month materially reduced the stock. A minute white spot on the egg resulted, in the course of two days, in a growth of fungus. The source of fatality is charged to careless handling in the process of picking, when the eggs were exposed to the higher air temperature of the room for unnecessarily long periods. On April 5 all were carefully washed, picked, and spread evenly on 81 trays, and the contents of several trays being ascertained by counting, the whole number was found to be 166,000. Hatching was observed as early as April 8, and at the end of the month no eggs remained. A subsequent table indicates the success attending the stock in the fry stage.

Brook trout.—Egg collections were from wild fish taken from Winkempaugh Brook, a tributary of Branch Pond, 10 miles distant. On October 19 two employees, provided with equipment for establishing a trap to arrest the progress of ascending fish, were dispatched to the scene. The trap was at once put in place, and eleven days after 1 male and 10 females were taken, from 5 of which, then ripe, 10,000 eggs were secured, these being delivered at the station the same day. The weight of one of these fish was about 5 pounds. During one night, about the middle of November, 34 female trout were taken. The ineffective arrangement of the trap permitted nearly all male fish to escape, and this, together with injuries sustained from the cutting of minks and muskrats, and a sudden freshet, led to the unobstructed passage of probably two-thirds of all fish ascending. There were 72 females captured, a portion of which escaped before their eggs were stripped. The Winkempaugh trout are the genuine *Salvelinus fontinalis*, ranging in weight from 2 to 5 pounds, and exhibiting brilliant markings. The collection of eggs amounted to 109,400, of which 8,500 were treated with milt of landlocked salmon without result. Besides the above, a few unproductive eggs were acquired from fish captured in the Great Brook traps. The eggs in development turned out poorly, as a result of defective fertilization, the greater portion being discarded by December, many of those remaining showing up as "ringers."

Other trout eggs.—Eggs additional to those already mentioned were in the nature of express consignments, represented below:

Date.	Kind.	Number.	Whence derived.
Jan. 18..	Atlantic salmon	10,000	Craig Brook Station, Maine.
23..	Von Behr trout	50,000	Northville Station, Michigan.
28..	Lake trout	50,000	Do.
28..	Loch Leven trout	30,000	Do.

On arrival there were dead, of the first three kinds named, 8, 13, and 16, respectively. A consignment of rainbow trout eggs arrived February 6 from Neosho Station, all having perished en route from delay consequent upon a railroad accident.

Fry.—All eggs were hatched in April and the fry were in good condition, except Atlantic salmon, and the parentage of this lot is mentioned under the heading of Green Lake Station. In order to accommodate and successfully care for the young fish in process of rearing, it was necessary to erect, in advance of more permanent constructions, a temporary outdoor stand containing 46 troughs. These, with 38 half hogsheads, arranged at the same point, and the interior troughs of the hatchery, afforded 126 receptacles. The supply conduit, 7,050 feet long, was ventilated by the removal of boards at more than 300 points, and for still more complete aëration 25 breakwaters were inserted. The flow was increased to permit the employment of 15 to 25 gallons of water per minute to each trough and tub. Four temporary ponds, to receive the waste of outdoor receptacles, were among the preparations.

Supplies of food, consisting principally of liver, were obtained at Bangor instead of Ellsworth at a reduced rate of cost. The older fry began feeding May 12, all others following before the end of the month. The approximate stock of fry May 31, with losses, is given below:

Kind.	On hand May 31.	Discarded.	Percentage of loss.
Landlocked salmon	164,000	5,937	3.4
Brook trout	6,000	555	8.4
Von Behr trout	49,000	1,412	2.8
Lake trout	46,000	2,521	5.1
Loch Leven trout	29,000	786	2.7
Atlantic salmon	8,000	4,389	35

The only material loss during June was through the instrumentality of a parasite which attacked and destroyed the greater portion of the lake trout and a relatively smaller number of salmon. A report on this subject, by S. G. Worth, contained the following:

The lake-trout fry in rearing-troughs, both outdoors and under shelter, were undergoing a higher rate of mortality than any other species, their bodies being dotted with white spots. It had been found that the treatment with salt, termed "salting," had lowered the death rate, practically ending it, but no solution of the malady was given. My examination showed that the spots on an average were the size of a common fly speck, scattered irregularly over the bodies of the fish, on the foreheads, sides, tail, and fin bases, and even on the extremities of these appendages. The spots were white with a tinge of blue, the blue being due, perhaps, to sky reflection. They were easily removed by a knife blade and came off immediately on contact with cheesecloth hand-net.

The fish had been feeding poorly and at first I thought the spots were pimples resulting from intestinal inflammation—in other words, an eruption. This surmise was strengthened by the limp consistency of the pimples, some of which were pointed at their apexes, the general appearance being that of mucus. Upon detaching specimens they had the appearance of clabber (sour milk), and under a pocket glass of low power I found irregular watery markings, occupying, in some specimens, 25 per cent of the area. Upon examining them patiently I discovered a movement in one and later in another, and finally seven specimens on the pane of glass, as if recovering from the shock incident to detachment, were all in motion, circling around at the rate of one-eighth to one-fourth inch per second. Hence I inferred that the spots were animals, parasites, perhaps the larvæ of some insect.

It should be stated that, in the report just referred to, the statement is made that in June Mr. Davis, fish-culturist at the Green Lake Station, witnessed the killing of four landlocked salmon by a horse-leech in one of the interior hatching-troughs, the deaths occurring within a few minutes' time. The fish of all kinds on hand June 30, the end of the fiscal year, are represented in the statement below:

Kind.	Hatched in the year—		
	1893.	1892.	1891.
Landlocked salmon	164,000	4,656	3,700
Brook trout	6,000	.....	.....
Von Behr trout	49,000	1,042	.....
Loch Leven trout	29,000	1,688	.....
Lake trout	30,000	.....	.....
Atlantic salmon	8,000	.....	.....
Total	286,000	7,386	3,700

The station being about 4 miles from the railroad point, and the traps at opposite ends of the lake being several miles apart, connection was established by renting a small steam launch belonging to the Reed Pond Land and Navigation Company. On the breaking of the launch's shaft, November 5, the station horse and small boats were used instead.

In December the air temperature on three or four mornings dropped below zero, the water in the hatchery descending as low as 34° F., the maximum for the month being 38°. An increased flow of water through the supply conduit, as a general protection against freezing, caused overflowings and the formation of heavy icicles upon trestlings where the ravines are spanned, requiring at times much labor in cutting away the accumulations. The first snow permitting sleighing fell January 10. Connection with the post-office was effected daily by sleigh over the ice on Green Lake after January 5, continuing until late in April, the ice being melted May 12, when steam-launch service was resumed. The air temperature in January was as low as −14°, the water in the hatchery ranging from 34° minimum to 36.5° maximum. In February one snow-fall of 27 inches occurred. In that month a temporary structure was stored with 25 tons of ice of 24-inch thickness. The April water temperature was 37.5° minimum and 46° maximum. When the ice broke up in the lake, May 6, the water rose above the station wharf, but by the end of the month it had fallen over 2 feet. The minimum hatchery temperature for May was 44°, maximum 64°, average 54.5°. Toward the end of the year negotiations were pending for renting a larger boat for service on Green Lake.

GLOUCESTER STATION, MASSACHUSETTS (A. C. ADAMS, MASTER OF THE SCHOONER GRAMPUS, IN CHARGE).

General overhauling of the station in preparation for the winter's operations commenced December 13, cold weather delaying this work considerably, the supply pump not being in readiness until January 10. The United States Fish Commission schooner *Grampus*, her crew acting

as spawn-takers, was employed in making egg collections. Fish being scarce off Gloucester, the schooner was stationed the greater portion of the time at Kittery Point, Maine, where regular supplies of eggs of fair quality were obtained from January 13 to March 13. As usual, a small run of codfish, available for spawn-taking purposes, appeared off Gloucester in November, but fish were generally scarce here throughout the season, the few eggs obtained being from the schooner *Odd Fellow*. Early in January the upper harbor became filled with ice and the weather was so intensely cold that the steam condenser, the waste from which is employed to increase the water temperature, became inoperative on account of ice formation in the pipes.

The collections from Kittery Point were obtained from vessels fishing in Ipswich Bay, the price paid for good eggs being $5 per 1,000,000. The collections were transferred to the station by messenger over the railroad, the greater part arriving in good condition.

There were no eggs obtained except of the codfish, and the first of these were secured January 14. On that date the harbor temperature was 31°, the warm water overflow from the steam condenser, available at that time, increasing the temperature in the hatching-boxes by 3°. The shipments from Kittery Point in January were 12,202,000, February 18,408,000, and March 29,200,000. The total number received was 51,581,000, of which 49,831,000 were good. The fry produced amounted to 20,142,000, these being liberated in the waters adjacent, within a few days after hatching. Operations by months are indicated below:

Months.	Eggs received.	Fry produced.
January	11,045,000	5,150,000
February	15,019,000	7,328,000
March	23,767,000	7,664,000
Total	49,831,000	20,142,000

On April 13 there were also received 1,753,000 eggs, of which 1,195,000 remained on hand unhatched when the station was closed, these being placed overboard.

This was a clear-water season until February 10, when a violent storm occurred, filling the water with sediment. There was less uniformity in the hatching of eggs and the fry were weaker than in the best seasons. The poorer quality of hatching was attributed to the low water temperature, which could not be controlled for the reason mentioned, but the larger portion of the fry were active, and the poorer lots—those which failed to straighten—were not included in the record of those distributed. One lot of eggs, February 16, consisting of 2,000,000, produced 76 per cent of fry.

Alcoholic collections of eggs and embryo fishes were prepared and transferred to the general office for use at the World's Fair. On April 17 the station was closed, Mr. E. F. Locke, fish-culturist, being left in charge of property.

WOODS HOLE STATION, MASSACHUSETTS (JOHN MAXWELL, SUPERINTENDENT).

Operations were on the usual basis, fish-cultural work consuming about eight months of the year. A large amount of interesting and valuable material, consisting of marine fishes, crustaceans, plants, etc., was collected April 1 to June 30 for transfer to the aquarial exhibit at Chicago. About 9,000 living animal forms were transferred, these representing 40 species. The lobsters were crated in seaweed. Large alcoholic collections were also made.

Codfish.—This was a poor season for hatching codfish. On October 27 the *Grampus* was detailed to make collections of adult fish, but between the date named and December 28 the total amounted to but 41. In order that success might be secured, Mr. Vinal N. Edwards, the collector at the Woods Hole Station, was sent out as pilot, but the great draft of the *Grampus* prevented successful handling in shoal water, where cod were most abundant. Numerous trips were made to Block Island, Nantucket Shoals, and Browns Ledge, but fish were too scarce to afford success. Eventually a contract was entered into with private parties engaged in fishing, and by purchase 275 additional fish were obtained, a total for the season of 316. On January 1 the *Grampus* sailed for Gloucester, operating there the remainder of the winter.

The total of eggs obtained was 2,883,000, taken December 13 to January 5 from 20 fish. The fry produced amounted to 850,500, a fraction over 29 per cent. It will be noted that this winter was one of unusual severity, and on January 6 a sudden change in temperature reduced the harbor water from 31° to 29°, causing the death of all adult codfish held in the inclosures awaiting the ripening of their eggs. The fish thus killed amounted to 204, and operations were abruptly terminated. Many of the fish in the harbor were killed, among them cunners, tautog, and eels. The statement below represents the work with codfish somewhat in detail:

Date.	No. of eggs taken.	No. of fish produced.	Per cent of fish produced.
December 1	370,900	175,000	47
2	278,200	Died Jan. 16	.....
3	208,400	Died Jan. 20	.....
4	510,000	225,000	44
5	1,066,300	400,000	37
6	273,900	50,000	18
7	50,000	Died Feb. 1	.....
January 8	50,000	Died Jan. 28	.....
9	75,000	Died Jan. 28	.....

The eggs hatched in periods of 552 to 904 hours, in a temperature varying from 31.25° to 33.75°.

Flatfish.—Parent fish of this species not being obtainable in large numbers, the amount of work done was limited. Only 17 spawning fish were obtained, March 20 and 22, the eggs amounting to 461,000 and the fry to 288,000. The period of hatching ranged from 552 to 576 hours, in temperature of 37.5°.

Lobster.—This was the most successful season of production, the operations extending from April 15 to June 22, affording 702 egg-lobsters, from which were obtained 10,037,000 eggs. The former practice of obtaining lobsters by the agency of the station employees was continued only in part, 86 lobsters being secured in this way, the remaining 616 by purchase. The buying of egg-lobsters out of season was made possible by the regular appointment of the superintendent of the station as a deputy for the enforcement of the fishery protective laws of the State of Massachusetts. This appointment came through Hon. E. A. Brackett, chairman of the board of commissioners of fish and game, and authorized purchase by the United States Fish Commission, the conditions being that all egg-lobsters should be returned alive to the water after removal of eggs and while being held for manipulation they should be kept in live cars bearing the names of the United States Fish Commission and the fish commission of the State of Massachusetts. The 86 lobsters captured by employees produced 895,000 eggs, the others 9,142,000. The young, liberated at the age of 24 to 48 hours, amounted to 8,818,000. In addition to the above there were liberated in July, 1892, 1,100,000, hatched from eggs collected in June of the preceding fiscal year.

The lobsters obtained by purchase were principally from the vicinity of Gay Head, weights running from 4 to 9½ pounds each, the price paid to fishermen being 5, 8, and 10 cents per lobster. A statement of operations by months, on a basis of 6,090 eggs to the fluid ounce, is given below:

Month.	No. of lobsters stripped.	No. of eggs obtained.	Egg yield per individual.		
			Greatest.	Smallest.	Average.
April	55	590,000	18,200	3,045	10,840
May	207	2,691,000	39,500	3,045	12,990
June	440	6,750,000	85,200	3,045	15,340

The time required for hatching under varying water temperatures is indicated below:

Month.	No. of hours hatching.	Temperature.
April	46 to 56 hours	51° to 53°
May	15 to 43 hours	53° to 59°
June	14 to 27 hours	59° to 66°

Mackerel.—Only three spawning fish were obtained, these by station employees, June 14. The yield of eggs was 434,500, which produced 368,000 fry. In a temperature of 62° the eggs hatched in 77 hours.

Sea bass.—Only nine spawning fish were obtained, these being captured by station employees on June 21. The eggs, numbering 1,332,000, hatched in 76 hours in a temperature of 63°, producing 1,189,000 fry.

In May and June investigations were made for the purpose of acquiring a more complete knowledge of spawning habits of the menhaden.

The plantings of young fish of all species during the year were made in neighboring waters, principally in Vineyard Sound.

The average temperature of water and its density were as follows:

Month.	Mean temperature.	Mean density.
December, 1892	37.9	1.0256
January, 1893	29.5	1.0256
February, 1893	29.4	1.0258
March, 1893	32.7	1.0256
April, 1893	41	1.0255
May, 1893	51.2	1.0255
June, 1893	61.2	1.0255

COLD SPRING HARBOR STATION, NEW YORK (FRED MATHER, SUPERINTENDENT).

The operations of this station had been jointly conducted by this Commission and that of New York, of which latter it was the property. The reduction made by Congress in the appropriations for the work necessitated a curtailment of expenses, and the association of the two commissions was discontinued with the close of July, 1892.

DELAWARE RIVER STATION (LIEUT. ROBERT PLATT, U. S. N., IN CHARGE).

In pursuance of the usual practice, the United States Fish Commission steamer *Fish Hawk* was employed in the propagation of shad on the Delaware River. This steamer during the greater portion of the year was occupied with special investigations concerning the oyster, etc., but on May 12 arrived at Gloucester City, N. J., to take up shad hatching. As in former years, the egg-collecting and the manipulation necessary to development and hatching were conducted by the crew of this steamer. The period of operations, May 15 to June 2, was rather more brief than usual, and the number of eggs collected was relatively small, as was the case also on the Susquehanna and Potomac rivers. The aggregate obtained and the numbers from separate fisheries were: Howell's Cove fishery, 4,540,000; Faunce's fishery, 3,751,000; Bennett's fishery, 2,117,000; Gloucester Point, 45,000; total, 10,453,000.

To obtain these, 233 shad were stripped, the average number of eggs per fish reaching nearly 45,000. Between May 23 and June 7 the fry were liberated, 1,573,000 being transferred to the Hudson River and 5,349,000 to the Delaware.

With the exception of May 23 to 26, the water was muddy. Temperature for May, maximum 68°, minimum 59°, mean 63.83°; for June, maximum 71°, minimum 67°, mean 68.20°.

On May 26 the eggs of a scale carp, obtained from the river, were taken and placed in a universal hatching jar, the fry therefrom appearing in 85 hours. The commercial fishermen at that time took quantities of carp which sold readily on the shores at 8 cents per pound.

In March and April, just prior to taking up shad-hatching, the *Fish Hawk* was engaged in the lower part of the Chesapeake Bay, capturing, with beam-trawl and otherwise, marine specimens, animal and vegetable, for the Fish Commission aquarium, World's Fair, Chicago.

BATTERY ISLAND STATION, MARYLAND (W. DE C. RAVENEL, SUPERINTENDENT).

The superintendent having been assigned to temporary duty in connection with the Columbian Exposition, the services of Mr. E. M. Robinson, a former employee, were engaged for conducting shad operations during April, May, and June. On April 25 spawn-takers entered the field, but the extremely cold winter preceding caused the season to be a backward one, and the water remained cool throughout the period of operations. In addition to the low temperatures, freshets filled the water with driftwood, fishermen being unable to operate much of the time. The worst visitation by muddy water occurred May 6, which was in the middle of the period when eggs are most abundant. As a result of unfavorable conditions, collections were very light between April 30 and May 10. Results are shown, by months, below:

Month.	Eggs collected.	Eggs transferred.	Retained for hatching.	Lost in station.	Fry produced.	Per cent hatched.
April	7,707,000	553,000	7,154,000	3,615,000	3,539,000	49.4
May	43,341,000	2,695,000	40,646,000	15,678,000	24,968,000	61.4
June	3,779,000	.....	3,779,000	1,141,000	2,638,000	69.8
Total for season	54,827,000	3,248,000	51,579,000	20,434,000	31,145,000	60.3

Of eggs shipped, 553,000 were transferred to Central Station by messenger April 28, to be used in making up a shipment for the illustration of hatching methods at the World's Fair. There were shipped by car No. 3, 1,708,000 for the waters of the Congaree River, South Carolina, the eggs being hatched en route. An additional consignment of 987,000 was made by car No. 3 to Dighton, Mass., for streams there, the fry being hatched on the car. Low temperature of water prevented eggs from developing in the time usually required, many remaining unhatched for ten or twelve days, and the fry from such, being too weak for distant transportation, were liberated in waters adjacent. Those so liberated amounted to 10,874,000.

The water temperatures from April 25 to June 6, compiled from observations morning, noon, and night, are set forth below:

Month.	Max.	Min.	Mean.
April	54	42	49.7
May	70	51	60.1
June	75	64	69.5

It was noted that carp were very abundant in the waters, and several reports of large numbers captured were brought in. On May 31 there was a capture of 2,700 pounds reported in a single haul of a seine.

On June 9 the temporary employees were dispensed with, operations ceasing, and on June 26, property having been inventoried and stored, the station was turned over to R. A. Davis, custodian.

BRYAN POINT STATION, MARYLAND (S. G. WORTH, SUPERINTENDENT).

Preparations for the opening were made by Mr. L. G. Harron, superintendent of aquaria, but his services being required in connection with the maintenance of aquaria at Chicago, he was ordered away early in the season. From that time the immediate supervision of the station was under W. T. Lindsey, custodian, the superintendent being detained at the general office in Washington by temporary assignment.

The cold of the winter preceding was almost unprecedented, and a poor fishing season followed. The running of ice in the Potomac seriously damaged the temporary wharf, and it was necessary to rebuild in the month of March. The river shore was not clear of ice until February 9. Employees were again quartered in tents, furnished by the courtesy of Gen. Albert Ordway, commanding the District of Columbia militia. The tents were ready for occupation April 9. The adoption of tent quarters became necessary on account of lack of buildings, but their use during three consecutive seasons has demonstrated that they are more desirable than one large building. Each tent accommodates two sleeping berths, and as the spawn-takers are usually paired off, and come in from their work at all hours of the night, it is found that by having sleeping quarters subdivided those who arrive early are less disturbed in sleep; moreover, from a sanitary standpoint it is found that tents are greatly to be preferred. As the weather is sometimes quite harsh during the shad-hatching season, even so late as in May, the tents were provided with heating stoves made of sheet iron, which, with the necessary piping and chimney pots, cost less than $2 each. By using shavings and finely split wood the tents could be warmed and made comfortable within two or three minutes' time.

On May 6 occurred the most severe freshet since 1889. Prior to this day the fishermen had a favorable outlook, the first gill fishermen having commenced operations as early as March 27, catching at that time 12 fish at a drift, and on March 31 some capturing as many as 22 at a drift. The results, however, were poorer than in some years. The seine operated by the Fish Commission was put overboard April 14, but, like all other fisheries, it was rather unproductive of eggs. The total results for the season were only 8,870,000. The eggs from all sources between April 17 and May 22, are shown in the statement below:

Bryan Point seine	939,000
Chapman seine	958,000
Tulip Hill seine	683,000
Stony Point seine	512,000
Gill fishermen	5,778,000
Total	8,870,000

Following the practice inaugurated more than ten years ago, eggs collected were transferred to Central Station, Washington, D. C., for hatching, consignments being made in crates by the Mount Vernon and Marshall Hall Steamboat Company's line, the April shipments amounting to 3,023,000, and those of May to 5,847,000.

In consequence of the poor success met with by commercial fisher-

men, operations were greatly reduced early in May, thereby bringing the season to an early close, and there being no productive work for the spawn-takers, two of the best-trained ones were transferred to Battery Island Station, that collections there might be increased if possible.

Water temperatures during the collecting season were as follows:

Period.	Maximum.	Minimum.	Mean.
	Degrees.	*Degrees.*	*Degrees.*
April 17–30	59	48	50.2
May 1–22	66	52	59

CENTRAL STATION, WASHINGTON, D. C. (S. G. WORTH, SUPERINTENDENT).

Following the assignment of the assistant in charge of the Division of Fish-Culture as the representative of the Fish Commission at the World's Columbian Exposition, the superintendent of Central Station, in addition to other duties, was temporarily placed in charge of the office of the Division of Fish-Culture. The history of operations with eggs handled is shown in the statement which follows:

Date	Kind.	Whence received.	Number of eggs.			No. of fry furnished for distribution.
			Consigned.	Received alive.	Transferred.	
Jan. 19	Rainbow trout	Wytheville Station	15,000	15,000	15,000	
24	do	do	10,000	9,697		8,662
24	do	do	15,000	15,000	15,000	
23	do	Neosho Station	15,000	14,686		12,411
25	do	do	17,500	17,500	17,500	
30	do	do	20,000	19,960		17,927
Feb. 2	do	do	29,000	29,000	29,000	
6	do	do	23,000	23,000	23,000	
Apr. 28	Shad	Battery Island Station	553,000	430,000	430,000	
Apr. 21 to May 26.	do	Bryan Point Station	8,870,000	7,874,000	1,027,000	5,614,000
			9,567,500	8,447,843	1,556,500	5,653,000

The rainbow-trout eggs transferred were consigned as follows:

Date.	Consignee.	Number.
Jan. 19, 1893	Emil Wurner, consul of Switzerland, Havre, France	15,000
20, 1893	do	15,000
26, 1893	R. T. Browning, fish commissioner, Oakland, Md	17,500
Feb. 2, 1893	Lloyd W. Dehawder, fish commissioner, Baltimore, Md	29,000
6, 1893	U. S. Fish Commission Station, Wytheville, Va	23,000

The shad eggs from Bryan Point Station, situated on the Potomac River, opposite Mount Vernon, were conveyed to Washington daily, by special messenger, who received them on the Mount Vernon steamer at Marshall Hall wharf, where they were delivered by the steam launch engaged in collecting. The first consignment, April 29, from Central Station, consisted of 1,223,000, by car No. 2, for hatching in the fish-cultural exhibit at Chicago, the shipment being made up in part from 553,000 eggs taken at the Battery Island Station. The second con-

signment of 234,000, by car No. 3, May 14, was for South Carolina streams at Columbia. May 1 to 9, there were transferred 1,444,000 fry, the first of the season, to the fish ponds, Washington, D. C., the object being, as in former years, to have them reared to fingerling size before liberation.

The product of the United States fish ponds located in Washington, D. C., reaches public streams and applicants through Central Station, fish being consigned from the ponds as required, stored in tanks, and subsequently counted and placed in vessels suitable for transportation. Many are counted out in carload lots, sometimes placed in the tanks in bulk, at other times in pails containing 25 to 150 fish each. Numbers are also sent by express shipment to States nearest Washington. To obviate complaints, indicating that fish were removed while in transit, a system of sealing the pails was introduced. The method consisted in passing a string through the handle supports and two small rings soldered on the edges at points equally distant between the handles, when the free ends were slipped through the openings in the lead seal. The sealing was then effected by means of a hand press, in all essentials the same as those used for sealing doors of railway cars. This method was so favorably received that the order was made for presses for each of three special cars and the Neosho and Wytheville stations.

A summary of operations with fingerling and larger fish is represented in the statement below:

Kind.	Whence derived.	Number received.	Number shipped.
Leather carp	United States fish ponds, Washington, D. C	33,629	72,341
Blue carp	do	2,122	
Scale carp	do	38,741	
Mirror carp	do	26	
Spotted catfish	do	1,270	1,235
Tench	do	336	336
Golden tench	do	20	20
Golden ide	do	398	271
Goldfish	do	9,424	
Do	Wytheville Station	3,815	11,926
Black bass	do	463	34,867
Do	Quincy Station	25	
Do	United States fish ponds, Washington, D. C	34,379	
Rock bass	Wytheville Station	950	787
Warmouth bass	Quincy Station	227	227
Crappie	do	165	165
Rainbow trout	Wytheville Station	9,784	9,111
Total		135,774	131,286

Among the improvements at the station was the introduction of an American watchman's time detector, with 12 stations distributed throughout the general offices, aquaria, etc.

The superintendent was instructed, in 1889, to develop a scheme for the production of artificial eggs, and more or less study was given the subject from that time. The question was satisfactorily determined, and in the early part of the fiscal year covered by this report supplies of eggs were prepared and shipped to the World's Fair. The method of producing them consists in passing resin through heated tubes of metal, the falling drops being received below in water. It was

found that eggs, representative of the shad and whitefish, could be closely imitated in roundness, size, and transparency. Those intended to represent smaller eggs, as of the Spanish mackerel and codfish, were produced by pouring melted resin through sieves from an elevation, the falling particles being caught in water. The latter class had to be screened to separate the different sizes, those made by means of tubes being practically uniform. During some months attention was paid almost wholly to the selection of substances which could be united to produce a composition of required specific gravity for eggs semi-buoyant and floating. Meantime the point of obtaining eggs of perfect roundness was solved, and while yet looking to the regulation of the specific gravity it was accidentally found that eggs of resin could be made to represent any desired specific gravity by subjecting them to solutions of salt water of relative densities. When this was ascertained it was readily seen that both kinds were possible from the same material, the brine for the semi-buoyant ones requiring to be weaker and for the floating ones stronger.

Another duty devolving upon the superintendent was that of assisting the Commissioner in preparing for and carrying out experiments for determining the relative value of artificial salt water as the basis of maintaining an exhibit of marine animals and plants at the Columbian Exposition. As it was impracticable to devise satisfactory means for circulating the small quantity of water with which he was experimenting, it was necessary to adopt the alternative of oxygenizing the water by means of air circulation. As long ago as October, 1888, while the Ohio Valley Exposition at Cincinnati was occupying attention, instructions were received from the Commissioner to establish a small number of aquaria in the west end of the building and provide therefor an air circulation. Attempts were then made to liberate air through rubber tubing gashed with a knife or perforated with pin holes, but without good results. Following this, tests were made with sections of grapevine and other twigs selected from the mass of driftwood found on the shores of the Potomac at the shad-egg station. Grapevine gave tolerably fair results, but in time it was discarded, and Mr. W. P. Seal, then in charge of the aquaria, adopted sponge, a crude alternative, which, being cut into small pieces, was thrust into holes punched into half-inch rubber tubing.

All former efforts to diffuse volumes of air through water in currents sufficiently minute to effect ideal aëration having failed, and the solution of the problem being dependent upon the application of air circulation, active steps were taken to discover a material of the desired porosity. Plugs were made in cross-section from various kinds of wood, with the hope of finding one of suitable porosity. Mr. L. G. Harron removed a dead branch from an American linden tree on the public Mall, and it was just what was desired. From that day the question of successful liberation of air in water, for our purposes, has been solved.

Supplies of dead limbs from the linden tree are obtained from Massachusetts avenue and also on B street, SW., after heavy storms. Subsequent trials with sycamore boughs were rather encouraging. The newly acquired knowledge led to the adoption of air liberators in all of the aquaria at Central Station, and formed the basis of the circulating process adopted a few weeks later in the fourth special car added to the distribution service. It also resulted in effecting the permanent introduction of an air compressor, with small iron piping as a conduit, in Central Station. Prior to this the aquaria had been supplied with air by a crude method, described on pages 2 and 3, United States Fish Commission Bulletin, 1890.

FISH PONDS, WASHINGTON, D. C. (RUDOLPH HESSEL, SUPERINTENDENT).

The product of this station consists of fingerling fish, there being annually stored and reared in one or more of the ponds, additional to the regular work, an average of 2,000,000 young shad, which are released in the fall months when they have attained a length of 3 to 4 inches. One of the difficulties met with here is in keeping down the growth of vegetation in the ponds. Since the flood of May, 1889, its removal has required the expenditure of a large amount of labor from May to November. Men go overboard with mowing scythes and cut the plants near the bottom, afterwards gathering with small boats and wooden rakes for transfer to the shore. The great weight of this material makes its removal laborious, even after placed on the banks; wheelbarrows are employed in transferring it to portions of the grounds where it can be put out of sight. In July probably 400 cart-loads were removed. It is necessary each October to thoroughly remove the vegetation to afford free passage of fish from all parts of the ponds to the receivers, otherwise the fish will not collect at the points desired, but scatter over the areas and be lost under the growth.

The drawing off of ponds commenced November 21, when the sorting and counting of fish was begun and continued for a period. The pond containing black bass was drawn December 1, and the sorting and counting occupied almost a week. Almost as quickly as ponds were freed from the year's production, it became necessary to take up their cleaning and preparation for another year's work, banks having been injured and the trenches in the bottoms leading to the collectors being filled with mud.

Carp.—The new pond, 5 acres area, being partitioned off, leather carp were produced on one side and scale carp on the other. Two small ponds, 40 by 60 feet each, were devoted to the blue-leather and blue-scale varieties.

Spotted catfish.—No definite observations could be made concerning the spawning habits of this fish, as it was in hiding during the spawning season. There were 8 spawning fish in the ponds, producing 1,300 young.

Golden ide.—No results were obtained from this species, in consequence of cold weather in the first half of April, whereby the eggs were destroyed.

Black bass.—From 15 black bass 34,500 young were obtained, 500 of which were 5 to 7 inches long, the remainder 2 to 3 inches. The larger and smaller ones were raised in the same pond, and it is inferred that difference in size was due to cannibalism. Much labor was required to supply food, the daily ration being about 15 pounds of fish and every other day 30 pounds, that quantity of live fish being obtained during the summer and fall in the vicinity of Observatory Hill. Small river fishes of no table value were secured by seines and small boats operated by regular employees. On September 8, the number of bass having been observed to be decreasing, and the small fish available as food for them having been greatly reduced, purchases were made of offal fish in the markets, 10 to 20 pounds being obtained daily.

Shad.—Shad fry amounting to 1,989,000 received from Central Station in the preceding fiscal year, May 5 to 10, were placed in a rearing-pond of about 5 acres and held for liberation in the Potomac, effected by the lifting of gates December 2. The number released was about 600,000.

The production of other species was: Leather carp, 35,000; scale carp, 46,700; blue-leather carp, 1,700; blue-scale carp, 2,400; spotted catfish, 1,300; tench, 356; golden ide, 398; goldfish, 9,500; black bass, 34,500.

In December preparations were made for the next season's spawning of black bass by the introduction of quantities of clean gravel into their spawning pond. The method of handling black bass at this station is to place a limited number of spawning fish in a small pond a few rods square in which the water is shallow, the bottom being covered with clean gravel, the small pond being connected with another, ten or twenty times as large, by means of wire screen of proper size mesh to permit the young to pass out. After the young have left the nest and obtained access to this larger and more fruitful feeding-ground they are safe from being eaten by their parents. In January, the Potomac River being filled with ice from Washington to its upper source, it was anticipated that a gorge would occur, resulting in the flooding of this station, and to avoid the loss of brood fish the ice was removed from 14 ponds, its amount being about 500 cart loads, and the fish stored in the brick vats and covered with netting. No freshet occurred; but so much damage from frost was sustained by water-pipes and valves, the cross-partitions in ponds, the banks of ponds, etc., that a great portion of the next four weeks was occupied in repairs.

During the later months of the year spawning by the pond fishes was accomplished, the results, however, only to be definitely determined in the fall months of the succeeding fiscal year. In furtherance of the practice adopted a few seasons ago, the first shad hatched at Central Station were delivered here for rearing in ponds, the number received this year, May 1 to 9, being 1,444,000.

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

This station is the property of the State of Virginia, but is operated by the United States Fish Commission. During the year improvements were made, chiefly in the nature of repairs, funds applied thereto being furnished by Dr. J. T. Wilkins, commissioner of Virginia, and labor by regular employees. The repairs were applied mainly to the rearing-ponds, broken embankments being overhauled and new piling introduced where necessary, and bottoms tamped with clay or cemented. Eight ponds were thus repaired. Water connection was established between the spring and the nursery building, the piping being extended to the railroad siding, where Fish Commission cars receive the product of the station for distribution.

The fish brought over from the preceding year in process of rearing consisted of rainbow trout in troughs; black bass, rock bass, carp, and goldfish in ponds, where they had been hatched by natural methods. In September the rainbow trout were culled, the various sizes being placed in separate apartments. These were counted in October in advance of distribution. In September nearly 12,000 were suffocated in the nursery building by accident, the supply gate having been temporarily shut off and forgotten. The distribution of this species was taken up November 16, and continued until February 14. Applicants in Virginia, North Carolina, Tennessee, Kentucky, Georgia, Pennsylvania, and Maryland were supplied. The number delivered to cars was 79,547. On account of depreciation in the quality of brood stock, 4,000 were retained to be reared for spawn-taking purposes.

Black bass distribution occurred between November 16 and March 10, 1,433 being furnished to applicants in Virginia, North Carolina, and Alabama. Of this species, 400 were received from car No. 3; but, being attacked by fungus, only 135 were available for distribution. A few were retained in order to increase brood stock.

The distribution of other species was effected on lists furnished from Washington, consignments being chiefly to adjoining States already referred to, transportation being made in tin pails. The movement of these fish took place between November 15 and March 10, the principal deliveries of all kinds taking place before the end of December.

The number furnished for distribution was larger than ever before, being as follows: Rainbow trout, 79,547; black bass, 1,433; rock bass, 13,650; carp, 5,168; goldfish, 5,990.

Contributions were made for the World's Fair exhibit, consisting of alcoholic specimens of eggs and embryos of the various species, and also specimens of destructive insects and larvæ.

Rainbow trout.—In the absence of new brood fish to make up deficiencies in old stock, the egg collections were somewhat inferior, and losses were heavy on account of the large percentage of hard or glassy eggs. The presence of eggs of this character having been previously observed, efforts were made this season to determine the cause, and accordingly Dr. R. R. Gurley, of the Division of Scientific

Inquiry, was sent to this station in December. Examinations with the microscope led him to express the opinion, in a preliminary report, dated January 17, 1892, that eggs of this character are the production of individuals, not existing among all and hence not epidemic; that the disorder was nonparasitic, but resulted from inflamed ovaries.

The trout began spawning November 18, continuing for 117 days; 18,000 were taken in November, 145,000 in December, 137,000 in January, and 70,000 in February. Eggs were taken from 310 fish, the average being 1,221 per fish, and the total 378,500. In addition, 81,500 eggs were received from Neosho Station, where the production was greatly in excess of the rearing capacity.

Eggs were transferred as follows:

Date.	Consignee.	Number.
Jan. 13, 1893	John W. Titcomb, fish commissioner, Roxbury, Vt	20,000
14, 1893	John H. Gordon, South Bend, Wyo	10,000
14, 1893	C. Raveret-Wattel, Fecamp, France	10,000
17, 1893	Central Station, Washington, D. C	15,000
18, 1893	G. W. Thayer, Provo City, Utah	10,000
20, 1893	J. G. Bluhm, Rio Negro, United States of Colombia	10,000
23, 1893	Central Station, Washington, D. C	15,000
28, 1893	John W. Titcomb, fish commissioner, Rutland, Vt	25,000
Feb. 7, 1893	S. S. Watkins, superintendent, St. Paul, Minn	20,000
	Total	135,000

The consignment to Utah was unsuccessful, owing to use of sphagnum moss which had not been sufficiently soaked in water, the expansion taking place in the egg crate and increasing bulk to an extent to crush the eggs. This was by oversight, it being the custom to give the moss a water bath for two or three days in advance of the shipment.

Although rainbow-trout eggs are handled in February and March, it is not practicable to make up shipments after January, as it is difficult to bring together enough of the same age.

Eggs lost at the station were 142,000, the fry hatched being 183,000. From those hatched 95,000 fry appeared in February. The fry commenced taking food in March, and in May all were sorted and counted.

Black-spotted trout.—The brood fish on hand, 31 months old, spawned in March, the first eggs being taken early in the month. These eggs were not sufficiently fertilized and were without effect. The females were four to six weeks later than the males in maturing. An attempt was made to increase the brood stock, and in July, 1892, fish of that year were forwarded from Leadville Station, Colorado. The number sent was 15,000, but only about 1,500 reached their destination alive, on account of sickness of the messenger in charge. Food supplied the young fish consisted of beef livers, from cold storage at Roanoke, Va., and from Washington, D. C. The older fish are fed on mush composed of common flour or shorts and liver, the proportion of the latter being about one-fourth of the whole.

Other species.—Black bass and other pond species were transferred in April to summer ponds, spawning-beds being constructed for them. The results were apparently satisfactory in all cases, it not being

known, however, at the end of the year whether the black bass had produced numerously or not, the young at that time being still in the spawning-beds. The rock bass and goldfish spawned in May, many of both species hatching during that month. The numbers of fish of all kinds on hand, counted or estimated, at the end of fiscal year, June 30, 1893, are represented in the table which follows:

Kind.	Year hatched.			
	1893.	1892.	1891.	1890 or earlier.
Rainbow trout	112,000	4,000	.....	2,000
Black-spotted trout	.....	300	200	.....
Black bass	.....	50	10	.....
Rock bass	20,000	.....	.....	200
Carp	8,000	.....	.....	50
Goldfish	8,000	.....	.....	100

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

Production was greatly curtailed by hard weather, there occurring in the eleven days after October 28 three gales of unusual severity, many of the fishermen's nets being injured so badly that they were pulled out for the season. There were also severe gales in the spring months, interfering with the collection of pike-perch eggs. All eggs taken, however, proved to be of fair quality.

Whitefish.—The collection of whitefish eggs was not commenced, owing to storms, until November 11, the season terminating November 23, with an aggregate of 50,080,000, derived from sources below:

North Bass Island, Lake Erie	22,690,000
Middle Bass Island, Lake Erie	5,600,000
South Bass Island, Lake Erie	14,310,000
Kelley Island, Lake Erie	5,590,000
Catawba Island, Lake Erie	1,400,000
Toledo, Lake Erie	280,000
Unrecorded	210,000

As many as two-fifths were from gill nets, and all were obtained through spawn-takers attached to the station, and paid for at the rate of 40 cents per liquid quart. Only eggs of good quality, were purchased, determinations being made by microscope immediately after segmentation.

On February 13 a shipment of 5,000,000 eggs was made to the New York Fish Commission, addressed to the hatchery at Clayton, M. B. Hill, superintendent. These, by error, were shipped by freight, and were on the road twenty days, and on arrival were found to be frozen. They were successfully thawed out, however, and Mr. Hill, in a letter dated April 10, gave the gratifying information that all were hatched and liberated with a loss of but 10 per cent. On February 27 a shipment of 5,000,000 eggs was sent to Duluth Station. Eggs retained produced 22,570,000 fry, which were liberated on reefs off the islands in the vicinity of Put-in Bay Station. In development it was discovered that those eggs which occupied the upper tier were of poorest quality. The reason for this was not definitely ascertained, but was supposed

to be due to the fact that the water to the upper tier was delivered through closed pipes, while that used in the lower tiers was from open troughs in which the water had been partially aërated.

With regard to measuring whitefish and other eggs, the following is from a letter from Superintendent Stranahan:

> Our plan for computing the number of fish eggs is to carefully measure out a fluid quart in water, draining until fairly dry, or to an extent that they will no longer drip. The eggs are then divided into two pans, which are part of the weighing scales, until they balance. One panful is then divided on the scales in the same manner until finally one-eighth of a quart is obtained, these being counted. The scales, prepared at the station, under my supervision, are so sensitive that the weight of one herring egg is indicated. Duplicate counts of one-eighth quart show variations of five to twelve eggs. To compute the number of eggs in the hatchery we take ten jars, introducing a quart of water into each, marking the level on the gauge, and taking the mean of the ten marks for the 1-quart mark. The second quart is then added to each jar, and so on until 5 quarts have been introduced. Lines are established on the gauge stick between quart marks to indicate pints and half pints. Cisco or lake-herring eggs are found to number 78,848 per quart, whitefish 40,000, and pike-perch 171,000.

The gauge employed is of wood, in the shape of a carpenter's square, the short arm resting across the top of jar, the longer one following the outside to the base.

Cisco or lake herring.—Active interest being exhibited by commercial fishermen in behalf of the propagation of this species, the collecting and hatching of their eggs was this year taken up, Messrs. Stone & Gilbert, Daniel Vrooman, and Frank Miller granting the eggs free of cost and affording facilities to spawn-takers. The collecting-grounds were on the shoals around Put-in Bay, operations being confined to November, aggregate collections for the month being 11,756,000. The fry resulting amounted to 6,500,000, and these, escaping simultaneously with the whitefish, were drawn into the same collectors and distributed together, shipping cans containing both species.

The opinion prevailing among local fishermen that a hybrid between the whitefish and cisco existed in those waters, an attempt was made to produce such a fish, the eggs used being those of the cisco. The number successfully fertilized was 588,000, of which 200,000 were shipped to Smethers & Thompson, Warren, Ind., for experimental purposes. The hatching was successful and the fry were liberated in one of their private ponds. A letter received June 9 represented that thousands of these fish, 2 inches long, were in sight around the inlet. The water in the pond was from an artesian well. Eggs retained at the station produced 200,000 healthy fry, which were liberated in Lake Erie at points in the vicinity of the station.

Lake trout.—When it was too late in the season a spawn-taker was dispatched to Dunkirk, N. Y., egg collections of lake trout numbering 400,000 being secured. A loss of more than 100,000 was sustained almost immediately, while the eggs were held in cans of running water. Those reaching the station amounted to 225,000, of which 25 per cent

died inside of ten days, and only 81,500 fry were produced, which were liberated on May 10 in Lake Erie. Lake trout have been but rarely observed in the vicinity of the station during the past twenty years, none having been seen in five or six years by persons familiar with the locality. On November 7, however, Mr. E. J. Dodge took from one of his trap nets a specimen weighing nearly a pound, and on November 19 he captured another, both being forwarded to the general office for identification. It is believed that the fish were of the 190,000 liberated from this station in the spring of 1890.

Rainbow trout.—On February 14 and 18 consignments of rainbow-trout eggs, aggregating 75,000, were received from Neosho Station, Missouri. They were in excellent condition on arrival, but underwent considerable loss both in the egg stage and as fry, the young available for distribution numbering 65,000. The fry, on arriving at the feeding stage, were liberated in the vicinity, in Lake Erie. Owing to lack of vitality it is feared that only a portion survived.

Pike perch.—Collections of pike-perch eggs aggregated 30,750,000, of which 25,564,500 were obtained from the shoals of Put-in Bay and the remainder from East Sister Island, Lake Erie, the season terminating April 19. The fry resulting numbered 20,200,000, of which 16,600,000 were delivered by the steam launch *Shearwater* at Sandusky, car No. 1 receiving 10,500,000, and car No. 2, 6,100,000. The remaining 3,600,000 were put in Lake Erie. The cost of pike-perch eggs, all items included, is found to be about $1 per million.

The distribution, exclusive of whitefish eggs, was as follows: Rainbow trout, 65,000; lake trout, 81,500; cisco, 6,505,000; whitefish, 22,570,000; pike perch, 20,200,000.

Important aid was rendered in World's Fair collections, the work being taken up March 29, terminating June 3. During that period four car loads containing 1,000 specimens, representing over forty species, were delivered for transportation to Chicago. Among these were 44 adult brook trout from the Castalia Trout Club, presented by Hon. John C. Zollinger, president of the club, and delivered to our cars at Sandusky. Mr. Zollinger also presented 2,000 trout eggs from the hatchery of the club, but these, owing to defective packing, perished en route.

An interesting development emanating from this station in connection with the World's Fair was the preserving of discarded fish eggs in brine for use in Chicago as representatives of good eggs in process of hatching. In 1890 Mr. Stranahan conceived the idea of illustrating hatching methods during summer, when active operations were suspended. Having succeeded fairly with his first trial, he concluded that something of the same character might be done at Chicago, and after experimenting he found that eggs could be successfully preserved in a brine sufficiently weak to permit their sinking slowly. The result of his observation and experiment proved highly gratifying in the fish-culture exhibit.

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

The operations consisted largely in handling eggs derived from brood fish held in ponds. The Alpena Station, however, being operated under the same superintendency, a certain amount of the work consisted in handling eggs of lake trout and whitefish. Improvements consisted chiefly in procuring an additional water supply from a creek and the construction of a new series of forty rearing-ponds, ten of the latter being completed before the year closed. There was a slight increase in the take of eggs and their quality was excellent. Attempted transfers of trout eggs to the Government of Japan were unsuccessful.

At the beginning of the year young fish on hand, in process of rearing, consisted of the following: Lake trout, 75,000; brook trout, 59,000; Loch Leven trout, 70,000; Von Behr trout, 64,000; total, 268,000.

The fish remaining on hand October 24, by actual count, were as follows: Lake trout, 38,644; brook trout, 34,986; Von Behr trout, 14,265; Loch Leven trout, 9,926; total, 97,821.

In consequence of intensely cold weather, subsequent losses reduced the numbers, those distributed being 23,600 lake trout, 19,900 brook trout, 3,400 Loch Leven trout, and 150 Von Behr trout. Some were retained for brood stock. In November a portion of the yearling fish were transferred from rearing-troughs to the new rearing-ponds. The cold weather in January so injured these ponds that it was necessary to make repairs after the disappearance of ice. The distribution occurred between January 24 and March 20.

Contributions to the World's Fair exhibit, Chicago, occupied quite a portion of the time of the superintendent, live specimens of the various trout mentioned, and of the black-spotted and rainbow varieties, of all sizes and ages from fry to four years old, being furnished. In addition, 64 glass jars of eggs and young of the various species, from earliest stages to 12 months' age, were furnished. Pike-perch eggs were also collected and forwarded.

In September, in advance of the egg-collecting period, hatching-troughs, trays, and other equipment were overhauled and asphalted, 150 new trays being provided.

Lake trout.—Between November 11 and 26 there were received from the Alpena Station, in four consignments, 2,051,000 eggs of lake trout. Their condition was only fair. Of these eggs, 955,000 were forwarded by express shipment, as follows:

Date.	Consignee.	Number.
Jan. 21, 1893	M. E. O'Brien, superintendent, South Bend, Nebr	100,000
21, 1893	M. A. Green, superintendent, Caledonia, N. Y	100,000
23, 1893	T. J. Griggs, fish commissioner, Spirit Lake, Iowa	100,000
23, 1893	S. S. Watkins, superintendent, St. Paul, Minn	100,000
24, 1893	C. C. Warren, fish commissioner, Roxbury, Vt	100,000
25, 1893	O. H. Daniels, Laconia, N. H	100,000
25, 1893	Green Lake Station, Hancock County, Me	50,000
Feb. 2, 1893	R. E. Follett, superintendent, Lime Rock, Conn	105,000
3, 1893	C. C. Warren, fish commissioner, Roxbury, Vt	200,000

There were retained at the station, for rearing, 250,000; these were highly successful in hatching, producing an equal number of fish, which were liberated in the inland lakes of Michigan and Indiana May 3 to 13.

Brook trout.—Through the courtesy of the officers of the Flint and Pere Marquette Fishing Club, arrangements were effected for obtaining adult brook trout from Kenne Creek, a stream controlled by them. The fish were readily secured in October by two employees of the Northville Station and Mr. George Brown, associated with the club. In four days 415 were secured with hook and line and transferred to the station without loss. Kenne Creek was first stocked in 1880, and in the first season of fishing, 1892, more than 5,000 fish were captured, none measuring less than 6 inches.

From original brood fish in ponds, 244,500 eggs were obtained from 285 fish between October 26 and January 12, and from the new stock of trout, practically between the same dates, 41,600 eggs were taken from 144 fish. There were retained for hatching 120,000, and transferred as exchanges, donations, or to other stations, 90,000, as represented below:

Date.	Consignee.	Number.
Dec. 26, 1892	Flint and Pere Marquette Club, Wingleton, Mich	25,000
Jan. 17, 1893	Troutdale Fish Farm Company, Mammoth Spring, Ark	5,000
26, 1893	S. S. Watkins, superintendent, St. Paul, Minn	20,000
Feb. 1, 1893	C. C. Warren, fish commissioner, Roxbury, Vt	20,000
6, 1893	U. S. Fish Commission Station, Clackamas, Oreg	20,000

Loch Leven trout.—Among brood stock there was a reduction to the extent of about 400, chiefly on account of deaths, but partly from the transfer of the parent fish to the World's Fair and to the aquarium at Washington, D. C. Between October 26 and January 16, 444,500 eggs were obtained from 764 spawning fish. There were retained for hatching 118,000, consignments to other hatcheries being as follows:

Date.	Consignee.	Number.
Dec. 26, 1892	Flint and Pere Marquette Club, Wingleton, Mich	25,000
Jan. 14, 1893	S. Chinda, Japanese consul, San Francisco, Cal	10,000
16, 1893	S. S. Watkins, superintendent, St. Paul, Minn	20,000
19, 1893	E. B. Hodge, fish commissioner, Plymouth, N. H	15,000
19, 1893	W. P. Greenough, La Chévrotière, Quebec, Canada	10,000
25, 1893	U. S. Fish Commission Station, Green Lake, Me	30,000
Feb. 1, 1893	Samuel Farbush, Hartland, Me	20,000
10, 1893	U. S. Fish Commission Station, Leadville, Colo	75,000
	Total	205,000

Von Behr trout.—There having been no addition to the stock of brood fish, a decline in eggs was perceptible. The spawning commenced October 26, when 6,750 eggs were obtained, and terminated January 7, the number taken on the last date being 1,750; the total product of 590 fishes was 375,800. The number retained for hatching was 112,000, and the transfers, aggregating 225,000, were consigned as follows:

Date.	Consignee.	Number.
Jan. 14, 1893	S. Chinda, Japanese consul, San Francisco, Cal	10,000
16, 1893	S. S. Watkins, superintendent, St. Paul, Minn	20,000
17, 1893	Otto Gramm, State treasurer, Laramie, Wyo	15,000
19, 1893	E. B. Hodge, fish commissioner, Plymouth, N. H	25,000
19, 1893	W. P. Greenough, La Chévrotière, Quebec, Canada	10,000
20, 1893	U. S. Fish Commission Station, Green Lake, Me	50,000
24, 1893	M. E. O'Brien, superintendent, South Bend, Nebr	20,000
Feb. 1, 1893	C. C. Warren, fish commissioner, Roxbury, Vt	20,000
2, 1893	R. T. Browning, fish commissioner, Baltimore, Md	35,000
2, 1893	R. E. Follett, superintendent, Lime Rock, Conn	20,000

Black-spotted trout.—In addition to the 940 already on hand, from the hatching of 1891, there were received in February, from Leadville Station, 2,287 fish of the hatching of 1892. The shipment consisted of 5,000, but owing to delays en route the greater part was lost.

Whitefish.—There were received from the Alpena Station, and forwarded February 20, by express, to the Fish Commission establishment at Duluth, Minn., 6,000,000 eggs of this species.

Pike perch.—For the purpose of illustrating fish-cultural methods in the exhibit of the Fish Commission in the Government Building at the World's Fair, Chicago, collections of eggs of this species, to the number of 16,550,000, were made on Saginaw Bay and Detroit River in April, Mr. Herschel Whitaker, commissioner of Michigan, cooperating in their obtainment. In addition, 154,000 eggs of the common sucker were secured and forwarded.

During March preparations were made for the care of the young fish derived from eggs held at the station, when the rearing-troughs were thoroughly cleaned and asphalted. The first were placed in rearing-troughs March 1. The mortality in May and June was somewhat unusual, and was charged to an insufficient supply of water and limited tank and pond areas. The number remaining on hand at the end of the fiscal year, June 30, 1893, together with other fish in ponds, is given in the table which follows:

Kind.	Hatched in the year—			
	1893.	1892.	1891.	1890 or previously.
Lake trout	75,000	.....	.....	.....
Brook trout	60,000	4,000	3,000	575
Loch Leven trout	58,000	.....	.....	1,700
Von Behr trout	44,000	2,300	.....	900
Black-spotted trout	.....	1,500	940	.....
Total	237,000	7,800	3,940	3,175

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

Operations consisted in collecting eggs of whitefish and lake trout, the former being hatched at this station to a large extent and the latter transferred to the Northville Station. Mr. S. P. Wires, as foreman, executed the fieldwork. In April, 1893, his services being required at the Duluth Station, he was relieved, E. A. Tulian succeeding him. In

September field preparations were made for anticipated collections of eggs from the commercial fishing-grounds on Lakes Huron and Michigan. These preparations were continued until late in October, in the meantime repairs being made to hatching-troughs, tanks, egg-trays, and spawn-taking outfit. In November a night watchman, second assistant, and others to comprise the spawn-taking force, were temporarily employed. Severe storms prevented the collection of the usual number of eggs.

Whitefish.—The first eggs were received November 8, consisting of 256,000, the total by November 30 amounting to 25,040,000. The losses while hatching were: November, 320,000; December, 1,180,000; January, 660,000; February, 240,000; March, none.

On the 22d of February 6,000,000 eggs were transferred by express freight to Northville Station for reshipment to the Duluth establishment. The eggs retained, 16,640,000, commenced to hatch April 17, continuing slowly until April 20, when, the water turning cold, very few additional ones hatched until the 23d, there being about 7,000,000 out by the end of the month. The last to leave the eggs came out May 8. The fry proved to be of excellent quality, and between April 27 and May 23 there were liberated 16,640,000.

Lake trout.—Eggs of this species were collected during November to the amount of 2,350,000, all being transferred to the Northville Station prior to November 30, in express freight consignments, as follows: 323,000 on November 11; 678,000 on November 17; 870,000 on November 22; 180,000 on November 26; total, 2,051,000. The shortage represents the loss. The majority were taken near Thompson, Lake Michigan, but 250,000 obtained from Lake Huron by means of tugs operating from Alpena were best in quality.

The water temperature November 1 was 42° F., and on November 30 it had fallen to 33°. From this date until April 13 it ranged from 32.5° to 33°. On April 19 it was 41°, on the 22d 38°, advancing after that date gradually to 41° on the 27th. From this date a gradual rise was experienced until May 27, when it was 56°. By the first of June the equipment was stored to await operations of the next fall.

DULUTH STATION, MINNESOTA (R. O. SWEENY, SR., AND S. P. WIRES, SUPERINTENDENTS).

R. O. Sweeny, sr., resigned the superintendency April 15, 1893, and S. P. Wires, foreman of Alpena Station, was appointed acting superintendent. On June 10 Mr. Wires was made superintendent.

In July the high temperature and generally unfavorable condition of the gravity water supply from Lester River rendered it impracticable to hold the young lake trout brought over from the preceding year, numbering 843,000. The surface of the water on the streams and lake was covered with a yellow powder, which on the lake was seen in areas 100 yards wide, 2 miles long, and 2 inches thick, consisting of the pollen of the flowerless plants of the family *Lycopodiaceæ*. On July 12

losses occurred amounting to 139,000, and as a result distribution was commenced, 340,000 being liberated in that month. The mortality continued, and during August 100,000 additional fish were liberated, completing the distribution.

Lake trout.—On October 1 preparations were commenced looking to the collection of lake-trout eggs at Isle Royale. This island, in the northwestern portion of Lake Superior, is an uninhabited wilderness of jagged rocks and tangled thickets, containing neither trails, paths, nor roads, and visited by one steamer only, whose service is irregular. At Grand Portage a few eggs were obtained from fish caught in pound nets, all others being from gill-net captures. The weather was exceedingly stormy, and the quality of eggs poor. The first eggs were received at the station October 4, packed in boxes. Other shipments followed throughout this month and in November, the spawn-takers returning November 19. Low air temperature destroyed a number of eggs in shipment and the shrinkage was great. Measured on December 13, the total number was found to be 1,527,000. The first hatching occurred 21st December, 10,000 having come out from the eggs by the end of the month, the last hatching occurring May 16. Fry were liberated in sixteen lots, March 8 to April 10, aggregating 850,000, there being left on hand April 15, 400,000 eggs and 695,000 fry. Losses in May amounted to 5,000, and in June to 15,000. There being a mortality of 6,000 on June 19, gravity water was discontinued, the pumps supplying water from the lake. Distribution during the month amounted to 1,075,000, deposited near the shores of Michigan and Minnesota, the total liberation during the year being 2,365,000.

Whitefish.—There were collected by station employees in the fall 750,000 eggs of whitefish, the number on hand December 13 being estimated at 500,000. This number being insufficient for stocking waters of that region, eggs were assigned from Alpena and Put-in Bay stations, 6,000,000 being received from the former, with a transportation loss of 18,000, February 24, and 5,000,000 from the latter station, with a loss of 300,000, March 1. Between April 1 and 10 four lots of fry liberated in the vicinity amounted to 145,000, leaving 10,382,000 eggs and 100,000 fry on hand April 15. During April 300,000 fry were liberated, and in May 10, 182,000, of which 2,982,000 were put out in the vicinity of the station, 6,000,000 near the shores of Wisconsin, 1,500,000 near the shores of Michigan, the last eggs hatching May 24. In December, 1892, young whitefish appearing in the vicinity of the station (an unusual occurrence), specimens were sent to Washington for identification.

Rainbow trout.—The Neosho Station being overrun with rainbow-trout eggs, two consignments were made to the Duluth Station, 75,000 being received February 11 and 25,000 February 15. The losses from date of receipt to April 15 amounted to 5,000, leaving on hand 20,000 eggs and 70,000 young. There were lost subsequently, 750 in April, 6,000 in May, and 250 in June, the last hatching occurring May 21. The distribution of 83,000 occurred in June, 43,000 being placed in the St.

Croix and White rivers, Wisconsin, and 40,000 in Sandy and Partridge rivers, Minnesota.

Pike perch.—In March preliminary arrangements were made for obtaining pike-perch eggs from Pike River, and on April 30 a personal reconnaissance of the locality was made by the superintendent. The collecting period was brief, extending from May 1 to 15, and owing to the slow disappearance of ice fully half of the fish had spawned before they ascended the river to the egg-collecting point where a seine could be used. The total of eggs amounted to 14,000,000. Of this number 500,000 were deposited in the stream where obtained, the remainder being conveyed to the station. The losses following transfer were 5,860,000 in May and 2,140,000 in June, hatching occurring June 1 to 5. The distribution aggregated 5,500,000, these being placed, before absorption of the sac, near the shores of Michigan, Wisconsin, and Minnesota.

Late in November there was a considerable fall of snow, and on December 10 ice above the dam from which gravity water is obtained formed to a sufficient thickness to cut off the supply to hatchery, enforcing the use of steam pumps in obtaining lake water from crib wells. In January the mean temperature was 5.66° below zero, and in February snow was more than 3 feet deep on a level, the ice at end of March above gravity dam being 4 feet thick. On April 30 the water temperature was 35°, and on May 10 the ice was still obstructing the passage of water to the hatchery from the gravity dam. By May 31 the average temperature of the water was found to be 39°, and in June it had reached the point of 70°. The distribution for the year was: Rainbow trout, 83,000; lake trout, 2,355,000; whitefish, 10,482,000; pike perch, 5,500,000; pike-perch eggs, 500,000.

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

The collection and distribution of native food-fishes from the overflow river basins was continued on the same basis as in former seasons. While this work does not aggregate large numbers of fish distributed, their larger size more than compensates for absence of numbers.

On July 15 the water in the Illinois and Meredosia rivers was found to be receding, the banks at that time just beginning to appear above the surface. On July 23 the water was still high, but falling, affording an opportunity for the commencement of operations in August, when both rivers and the overflowed lands were worked. All collections are secured with seines, the fish being transferred by small boats and a special steamer to the railway tracks, where the cars are in attendance. The difficulties in prosecuting this class of work are great, one of the worst being the high temperatures prevailing in air and water. A large proportion of the fish captured were taken from water only 4 to 8 inches deep, with an underlying deposit of soft mud 10 inches or more in thickness, and in hauling the nets it is impossible to avoid drawing ashore quantities of this substance, thereby suffocating the fish unless quickly removed. Another difficulty is in securing at the

right time a sufficient number of fishes of prescribed kinds to make up a carload consignment. Were it possible to make up carloads of any and all kinds a large amount of time would be saved, but large numbers are taken that can not be utilized in making up a particular shipment, and the fish must be separated and some transferred to storage for filling subsequent orders.

It is found that there is a wide variation in the abundance of the different species in different seasons. There may be one year a very plentiful supply of a given kind, and another year the same species may be conspicuously scarce. There is a similar variation in the abundance of species in the different localities. A particular pond may, one year, produce a large number of black bass, but another season will perhaps contain practically none. When large quantities of fish are secured the surplus is placed in storage ponds, as the fish can not be successfully held in live cars. The common practice is to return all of the more common varieties to the waters immediately around.

On Meredosia Island quite a large storage pond, not altogether safe from freshets, was provided for the holding of the surplus or reserve catch. When operations began some fish were in these ponds from June of the fiscal year preceding. Another pond for breeding purposes, situated near Naples, was secured. It is near the Illinois River and above high-water mark, and a number of large black bass were this season introduced in it with the object of securing young bass the next season. A noticeable feature in the operations this year was the presence of great numbers of carp, quantities being taken with haul seines, they being as numerous, relatively, as any native species. In that particular locality they were consumed as food in greater proportion than any other kind. Young carp hatched in the spring of 1892 were so abundant that they were caught with hook and line at every point on the two rivers, their length being 6 to 10 inches. Operations were very much benefited by rains which fell about September 10, cooling air and water.

The periods during which the cars were engaged in the movement of fishes are as follows: Car No. 1, September 24 to December 2; Car No. 2, August 11 to October 30, and Car No. 3, August 7 to November 5. The facilities for the transportation of the cars afforded by the railroad companies were the best yet secured, the officials being not only courteous, but furnishing a greatly increased amount of free transportation. The assistance furnished was of such importance that to this source is to be attributed in large part the accomplishment of the best season of work at this place. The number of fish sent out was not larger than in any previous year, but they were larger in size, many black bass weighing 2 to 3 pounds, but those averaging about a pound being the more numerous. When liberated the fish were counted, and with very few exceptions they were counted when loaded on cars.

A large area of territory was covered in the distribution, comprising Arizona, Colorado, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Missouri, New Mexico, Ohio, Oregon, South Dakota, Ten-

nessee, Virginia, Washington, and Wisconsin, some fish also being transferred for distribution in the New England States and to the District of Columbia. The mileage of the several cars is shown below:

Car.	Free.	Paid.	Total.
No. 1	6,612	1,567	8,179
No. 2	15,127	2,663	17,790
No. 3	15,010	2,921	17,931
Total	36,749	7,151	43,900

That the distribution was highly satisfactory may be seen from the statement below, indicating the successful liberation of 64,633 fish out of 67,187 delivered to the cars:

Kind.	Furnished for distribution.	Lost in transit.
Catfish	7,811	80
Yellow (or ring) perch	4,454	126
Pike-perch	845	.....
White bass	1,877	167
Black bass	33,987	470
Warmouth bass	5,670	671
Crappie	10,754	814
Sunfish	1,756	194
Pickerel	133	32

A consignment of fish, representing the different species, forwarded to the aquaria at Central Station is not included in the statement above. Cold weather early in January terminated the regular season, and the work subsequently consisted in making collections in May and June and forwarding to the aquaria at the World's Columbian exhibit.

NEOSHO STATION, MISSOURI (WILLIAM F. PAGE, SUPERINTENDENT).

The superintendent was specially detailed to assist in examining the site of the proposed station at San Marcos, Tex.; he also accompanied Car No. 2 during the distribution of the rainbow-trout yearlings in order to inquire into the cause of mortality among them in transportation. Examinations were also made with the view of obtaining pike-perch eggs from the vicinity of Baxter Springs, Kans., and of the overflow district of northeastern Arkansas, along the line of the Kansas City, Fort Scott and Memphis Railway, for determining the possibility of collecting and distributing native food-fishes from river swamps. An addition to the station was made in the nature of a trout pool 6 by 60 feet, planked with 1½-inch oak, with the expectation of its holding during the rearing stage 25,000 rainbow trout.

A satisfactory number of trout were brought over from the last fiscal year for rearing and liberation in the fall months, but the production of black bass was below the normal, and the carp were few in number and of too large size for successful pail shipments. On hand October 24, 1892, as determined by actual count, there were as follows: Rainbow trout, 40,266; brook trout, 1,200; tench, 19,000; black bass, 2,174; rock bass, 9,548; goldfish, 1,490; carp, 670; total, 74,348.

Owing to the quantity of work in the distribution service these fish could not be liberated with sufficient promptness, and the following losses occurred: Brook trout, 100; tench, 3,872; black bass, 204; rock bass, 548; goldfish, 553; carp, 36; total, 5,313. The losses among rainbow yearlings were very small, they being held in rearing-ponds under normal conditions up to the time of delivery to car messengers.

The 3,500 brook-trout fry brought over were diseased and continued to die until the last of September, when the survivors suddenly commenced growing rapidly, and those remaining for distribution were in fine condition.

The distribution of rainbow trout occurred between December 23 and March 31, the deposits being made chiefly in Missouri, Arkansas, Texas, Kansas, Illinois, and Iowa. The tench were shipped between December 3 and March 20, being placed chiefly in the waters of Missouri and Texas. Black bass and rock bass were liberated between January 19 and March 15, these being sent chiefly to Kansas and Missouri.

The distribution was as follows: Rainbow trout, 38,684; brook trout, 1,000; tench, 14,855; rock bass, 9,000; black bass, 1,968; carp, 634; goldfish, 937; golden ide, 10; total, 67,088.

In addition, 200,000 fingerling shad were liberated in waters tributary to the Gulf of Mexico. Their number could not be ascertained except by estimate, owing to the fact that these fish can not be successfully handled. They were the product of 700,000 fry sent from Washington in the preceding June. In preparing for their release the hatchery branch was in October cleared of shoals, drifts, and aquatic plants for three-quarters of a mile to a point where it empties into Hickory Creek. Early in November, when the branch was swollen by rain water, the 6-months-old fish were allowed to pass through open gates. They were some hours in escaping, a continuous silvery mass. These were the first fingerling shad planted in waters tributary to the Gulf of Mexico.

The pond which contained the shad was infested with crawfish, 1,750 pounds being removed and destroyed between August 3 and October 31. These were estimated to be 70,000 in number. By some unaccountable means black bass of the large-mouthed variety were also present. In preparing for receipt of the shad the pond had been drawn in November, 1891, and the bottom exposed for three weeks, and in the following April the process was repeated, all water connections with black-bass ponds having been broken and an independent supply being established. On August 3, the intruding fish being observed, a hook and line were brought into use, and on the first day 5, averaging 1½ pounds each, were caught, and by October 31 the catch had reached a total of 152. It is believed that they burrowed in the mud, surviving the absence of water during the two periods mentioned. It is not definitely known that the black-bass lived imbedded in the mud during these periods, but the indications point to the correctness of this supposition.

A large amount of material was furnished for exhibition at the

World's Fair, and to the World's Fair commissioners of the State of Missouri. Specimens of fish and other natural-history collections were furnished to Prof. S. E. Meek, curator of the museum of the Arkansas Industrial University.

Of the rainbow trout brought over from the preceding year, 1,500 were set aside for brood fish. These were weighed and measured in February and fed for sixty-three days on a diet consisting of 2.85 pounds of beef liver and 15.5 pounds of mush made of mill shorts. During the succeeding twenty-seven days they were fed on 4.44 pounds of liver compounded with 22.94 pounds of mush. On the dates April 26, May 20, and June 19 they had progressed from the aggregate weight of 140.5 pounds to 390, 480 and 522.2 pounds, respectively. The cost of each pound at the end of the first period was 3.6 cents, at the end of the second 1.16, and at the end of the third 6.5, the price of liver being 4.5 cents per pound.

Dried blood in conjunction with mush was tried without good results, owing to the fact that the substance could not be reduced to its original state so as to freely mingle with the farinaceous matter. Experimental tests were made with cotton-seed meal. A trial with purely farinaceous diet was made with rainbow-trout fry with satisfactory results.

Examinations for *Gammarus* in the surrounding streams having demonstrated that none was present, 1,000 were obtained in December from the Mammoth Spring, Arkansas. Introduced into the black-bass ponds, all apparently were destroyed, but in the others they multiplied. An attempt to convert into fish food the crawfish destroyed was unsuccessful, as the time consumed in handling was not economically invested.

Rainbow trout.—This species has attained unprecedented growth in the ponds of this station, where it has been demonstrated that they will spawn the second year. All reports concerning the growth of fish liberated in the waters of the Ozark region have been encouraging.

On December 14 the 3-year-old brood fish commenced to spawn, and by December 30, only 23,000 eggs having been taken, it became evident that the parent fish would not enter the spawning race. Thereupon a haul seine was applied to their capture every day until the close of the season, March 7. The quality of the eggs being superior to those taken last year, the conclusion was reached that the hard and glassy kind heretofore puzzling the minds of all concerned were the result of overretention. In the preceding year, when the spawning race was depended upon, 60 per cent of all eggs taken were of the kind named, while this year none were of that character. Hence, it is inferred that the hard and glassy eggs may be avoided by seining, and taking eggs from fish as soon as mature. The total from 730 females was 672,526, of which, 84½ per cent, or 542,868, were fertilized, the average number of eggs per fish being 935. Of the fish stripped, only 79 voluntarily entered the spawning race, all others being forcibly captured.

As this station was equipped and designed to hatch only about 60,000 eggs, it was impracticable to care for the number obtained, and 21

lots of eggs, aggregating 463,500, were shipped to other points, as shown by the following statement:

Date.	Consignee.	Number.
Jan. 17	H. M. Garlichs, Missouri fish commissioner	20,000
20	Central Station, U. S. F. C., Washington, D. C	15,000
21	do	17,500
25	do	20,000
25	Wytheville Station, Wytheville, Va	15,000
27	do	15,000
28	do	33,000
30	Central Station, U. S. F. C., Washington, D. C	29,000
Feb. 1	do	23,000
2	C. C. Warren, Vermont commissioner	36,000
6	Green Lake Station, U. S. F. C., Green Lake, Me	30,000
6	Duluth Station, U. S. F. C., Duluth, Minn	14,000
7	do	45,000
8	do	16,000
10	do	22,000
10	Put-in Bay Station, U. S. F. C., Put-in Bay, Ohio	21,000
13	do	27,000
14	do	20,000
15	do	7,500
24	M. E. O'Brien, superintendent Nebraska Fish Commission	21,000
Mar. 3	do	16,500
	Total	463,500

With the exception of one package lost in a railroad accident while en route to Green Lake Station, the eggs were received in good condition and were pronounced to be of high grade. No sphagnum moss being available for the unexpected shipments, fine shavings of common grades of sponge were used for packing the eggs on the canton-flannel trays. It was found that a much larger amount of labor was required to prepare it than sphagnum moss, but, its expansibility being more uniform, the pack could be much more evenly effected and with greater safety. Moreover, this material can be reused upon being subjected to boiling. One pound is sufficient to pack 15,000 eggs, it not being used in the outside packing employed to exclude atmospheric heat.

The eggs retained for hatching and rearing were 74,700, which by April 17 afforded 60,000 fry, then placed in pools for rearing. The eggs being of different ages, the hatching was prolonged until March 26. Losses in fry during the hatching process were 7,838, of which 6,051 were killed by the choking of an inlet pipe by a small fish.

In May an epidemic occurred in one of the pools, about 8,000 fry dying, but the mortality was soon arrested by applying salt and earth.

Pond species.—In February preparations were commenced in anticipation of the spring spawning of pond fishes, the water areas being drawn and cleaned and all necessary materials brought together in proper condition. In the four weeks succeeding April 10, constituting the height of the spawning and hatching season, there was a rainfall of 8.8 inches, accompanied by five severe hail-storms and three wind-storms, the latter carrying bunches of moss and willow roots laden with glutinous eggs out of the ponds, thousands of additional eggs and young being destroyed by hailstones and raindrops. Owing to the flooded condition of the large streams there was an influx of

aquatic birds, many of which attacked the pond stock, capturing some of the spawning fish from off their nests of eggs. For nineteen days it was necessary to have the station patrolled by one of the employees, during which time eight fish-hawks were killed. This station is not only infested with crawfish, but by many wild animals, and constant vigilance on the part of employees is necessary. The records show the following as having been caught during the fiscal year: Kingfishers, 9; wild duck, 52; gull, 1; grebe, 9; water-hens, 11; fish-hawks, 9; bittern, 15; heron, 3; egret, 1; owl, 1; turtles, 43; snakes, 98; frogs, 794; muskrats, 7; raccoon, 1; mink, 1; water rats, 15; crawfish, 267,460.

The black bass began to prepare nests toward the end of April, and by May 15 as many as 15,000 young were transferred from the nests to unoccupied ponds. A larger number could have been transferred had the pond area been available. The tench, which spawn at this station at two years of age, deposited their eggs by May 15. The golden ide spawned profusely April 7, but without effect. An attempt was made to artificially handle a portion of the eggs, but without success, all being found covered with fungus at the expiration of ten days. The eggs flowed freely and were apparently in good condition. In color they were dark brick-red. In August, 1892, the rock bass were found to be spawning for the second time in that calendar year. The channel catfish again, for the third season, failed to deposit eggs, for reasons unknown, every care having been bestowed upon them.

The rainfall for the year was 37.3 inches, the fall of snow being 10.75. The maximum air temperatures in July and August were 105° and 102°, respectively, the lowest temperatures being reached in December and January, the thermometer registering 8° below zero in the latter month. The extremes of temperature in trout ponds were 80° maximum and 32° minimum; in black-bass ponds, 88° and 36°. Ice gathered from the ponds and stored in December was 6 inches thick, and comprised about 60 tons. The fish remaining on hand June 30, 1893, of all kinds, are represented in the statement which follows:

Kind.	Hatched in—			
	1893.	1892.	1891.	1890 or earlier.
Rainbow trout	52,000	1,000	.....	1,000
Black bass	3,000	.....	.....	25
Rock bass	10,000	.....	.....	115
Carp	8,000	.....	6	30
Catfish	.....	.....	.....	20
Tench	20,000	.....	.....	25
Golden ide	.....	.....	4	16
Goldfish	2,000	.....	.....	29

LEADVILLE STATION, COLORADO (H. D. DEAN, SUPERINTENDENT).

Work was confined to the salmonidæ, the fish liberated being of yearling size, and the output larger than in any previous year, amounting to 178,900 fish and 60,000 eggs.

In addition to repairs to the old hatching-house, 14 new rearing-ponds were prepared, the smallest being 5 feet wide and 15 feet long,

and the largest 15 by 40. These were constructed with plank sides, the smaller ones being also planked on the bottoms.

As the result of the breaking of the bank of the lower lake, May 27, the water supply for a month was obtained from the De Mary irrigating ditch. As the temperature of the lake water rose to 70° F. in the warmer portion of the day, half of the station supply was obtained during summer from the ditch. In September the establishment was threatened with forest fires, requiring some labor to save the building. A snow-fall of 5 inches, October 31, removed the danger.

Egg collections were made at two periods, the first from November to January, inclusive, and the second in May and June. There were brought over from the preceding year eggs and fish represented in the table which follows:

Kind.	Eggs.	Fry.	Yearling.	Two years old.	Brood stock.
Black-spotted trout	144,983	91,168	321	733	938
Yellow-finned trout	.....	1,755	1,314	.....	.....
Rainbow trout	3,145	1,900	.....	30	3
Brook trout	.....	169,492	1,907	1,480	93
Von Behr trout	.....	56,190	.....	.....	.....
Loch Leven trout	.....	12,013	.....	105	.....

Of the eggs of the black-spotted trout there were shipped in July the following: H. M. Orahood, Denver, Colo., 30,000; G. Schnitger, Laramie, Wyo., 25,000; Otto Gramm, Laramie, Wyo., 5,000; total, 60,000. All the other eggs were hatched, 15,000 black-spotted fry being transferred to the Wytheville Station in July.

Losses among the younger trout, undergoing rearing, may be inferred from the following statement of numbers on hand September 30, by count: Black-spotted, 77,100; yellow-finned, 250; rainbow, 1,800; brook, 105,300; Von Behr, 34,000; Loch Leven, 4,900; total, 223,350.

Distribution was effected between November 12 and December 24, the fish being sent for the most part to Colorado, Montana, North Dakota, Nebraska, and New Mexico. Those furnished for distribution are as follows: Loch Leven, 2,600; rainbow, 1,550; Von Behr, 30,050; brook, 98,200; black-spotted, 46,500.

In November 5,000 black-spotted yearlings were transferred to Northville Station. There were also distributed 23,000 hybrid trout, 300 of which were forwarded to the Central Station, Washington, D. C. As a result of attempting to hold over a considerable number of yearling Von Behr trout during the winter, 17,000 were lost, it being impracticable to induce them to take food in the low water-temperature prevailing.

Materials collected and forwarded to the World's Fair, Chicago, consisted of black-spotted and yellow-finned trout, showing development up to six years. Adults, 375 in number, reached destination without loss. In addition to the live fish, alcoholic specimens of ovaries, eggs, and embryos were furnished.

Brook trout.—Observations at this station point to the superiority of the brook trout over all others for Colorado waters, native varieties not being excepted. In October, when the adults were placed in the

spawning-ponds, it was found extensive losses had been sustained and, to compensate, 900 fish, weighing on an average about 0.3 pound, were purchased. It was believed that missing fish had been stolen, or possibly destroyed through cannibalism.

Eggs were obtained from three sources, the ponds of the station, Uneva Lake, and the private ponds of Dr. John Law. The collections were satisfactory in number, but inferior in quality. The first were taken October 28, the total collections from the station ponds being 268,800, of which 205,000 were obtained during November. Nine trips were made to Lake Uneva, where 70 adult trout, weighing nearly 3 pounds each, and 153,600 eggs were collected in November. The owners of the fish, Messrs. Searl and Lazenby, by way of return, received 25 per cent of the fry in the summer following. After Dr. Law's hatchery had been filled with eggs, he allowed the remainder to be taken by the United States Fish Commission, and in December 50,000 were secured.

Both those eggs from Uneva Lake and Dr. Law's establishment proved to be of poor quality, 50,000 from the former place having been discarded by December 31, and 40,000 from the latter by February 28. The losses were attributed to defective fertilization. It is, moreover, believed that the prolonged period of incubation, on account of low temperature of the water, is of great disadvantage, eggs not being hatched till the end of five months. The temperature throughout this period remained at 34° F. On January 31 the eggs in Dr. Law's hatchery, in a temperature of 43° to 44°, were nearly all hatched, they having been taken in the month of November.

Black-spotted trout.—The results with this species in small breeding-ponds have not been satisfactory. Out of about 4,000 adults captured and confined at the station during the four preceding years, but 800 were this year surviving, and it is believed that the only source of dependence for eggs will be on wild fish in open streams and lakes of this region, the most inviting field being Twin Lakes. Eggs collected amounted to 118,600, all at the station except 18,000 from Sweetwater Lake. Attempted collections at the latter place were in conjunction with the State fish commissioners of Colorado. The first eggs of the season were taken May 25, collections for that month amounting to nearly 35,000, and in June about 83,000. A shipment of 20,000 was made to the World's Fair, Chicago.

Rainbow trout.—In June there were taken from fish confined in the ponds 6,200 eggs, of which 5,665 remained on hand June 30, 1893.

Loch Leven trout.—Eggs to the number of 75,000 were received from the Northville Station by express freight February 14. On unpacking they appeared to be in good condition, but on the succeeding day as many as 10,000 hatched prematurely. The hatching of the remainder was normal, but before the feeding stage was reached about 65 per cent perished.

In February the mean air temperature was 15°, with a snow-fall of 5½ feet. This remained on the ground to such an extent that in the

month of April it was necessary to shovel out a mile of the road to Leadville several times in order to obtain supplies. In the latter month outdoor operations were resumed to a slight extent, and in May the ponds were cleaned and those injured by heaving of ice were repaired. At this season black-spotted and rainbow brood trout were transferred to spawning-ponds. The full stock of eggs and fish on hand at end of fiscal year, June 30, 1893, follows:

Kind.	Eggs.	Fry.	Yearling and two years old.	Brood fish.
Black-spotted trout	57,589	.....	.....	977
Yellow-finned trout	.....	.....	1,060	.....
Rainbow trout	5,665	.....	.....	28
Brook trout	.....	74,032	6,338	1,414
Von Behr trout	.....	.....	1,450	.....
Loch Leven trout	.....	22,368	1,970	27
Total	63,254	96,300	10,818	2,446

BAIRD STATION, CALIFORNIA (LIVINGSTON STONE, SUPERINTENDENT).

The production of this station, consisting almost exclusively of quinnat salmon eggs, is largely transferred to the commissioners of the State of California. At their hatchery at Sisson the eggs are hatched and fry liberated under direction of those authorities.

Mr. G. B. Williams resigned the superintendency and turned over the property of the station July 29. He was succeeded by Mr. Livingston Stone, who had charge of these operations at their installation, he reporting August 10.

The first salmon yielding eggs was caught August 13, the fish, however, at that time being too scarce to warrant regular hauling of seine. On August 24, regular work being started, 44,000 eggs were taken. The California State law, permitting proprietors of canneries to operate seines until September 1, enabled those operators to catch nearly all the summer run of fish in the lower part of the Sacramento River, and the take of eggs from the summer run amounted to but 834,000. Egg operations lasted only nineteen days, during which time 220 spawning fish were handled. All eggs taken, with the exception of about 500,000, were forwarded to the State hatchery at Sisson.

Egg collections from the fall run of fish commenced October 20, the number obtained being 2,273,000. At this time funds having been exhausted, operations would have ceased but that the California commissioners came to the rescue and paid expenses during a period of about one week, there being obtained through their efforts 423,000 additional eggs. The whole number of salmon spawned during the fall run amounted to 620, the eggs produced being 2,696,000, and the aggregate for the year being 3,530,000. Work was abruptly stopped November 26 by a violent snow-storm. The eggs taken from the last run were forwarded to Sisson.

Storms were frequent and of severe character. In October 250,000 eggs were destroyed by high water, and in December the McCloud River was swollen to a height of 17½ feet, no mails being received during a period of ten days. The current wheel, supplying the hatchery with water, escaped damage, and at the end of the season was taken to pieces and stored.

In the statement which follows it will be seen that 533,100 young salmon were liberated at the station, these having been placed in the McCloud River in December. Egg transfers to the California commission are shown by dates.

Date.	Run, etc.	Number.
Oct. 9	Summer run	300,900
Nov. 30	Fall run	477,000
Dec. 5	do	513,600
17	do	541,000
29	do	248,000
2	Fry liberated	533,100
	Losses, including 250,000 resulting from storm	916,400
	Total	3,530,000

Rainbow trout.—In January preparations were made for the collection of rainbow-trout eggs to be forwarded to Japan, and for that purpose 10,000 were secured. These were transferred in five consignments during March and April to Professor Sasaki, agricultural and commerce department, Tokyo, four shipments arriving in satisfactory condition. In January a new seine boat was built for future use in capturing adult salmon. In April a survey was made looking to a gravity supply of water from a neighboring stream, and after its completion the scheme was considered practicable. In June work was commenced on the rack across the McCloud River in preparation for next year's supply of adult fish, no salmon being permitted to ascend after June 30.

A collection of salmon eggs and fry, together with their natural enemies and food, was prepared in alcohol and sent forward, to be included in the exhibit at Chicago. The 7 a. m. air and water temperatures for the year are shown below:

Month.	Air.			Water.		
	Max.	Min.	Mean.	Max.	Min.	Mean.
1892.	°	°	°	°	°	°
July	68	42	57.80	60	52	54.35
August	66	40	55.58	56	52	52.61
September	64	44	51.6	53	50	51.76
October	50	33	42.77	50	43	45.87
November	51	25	39.63	43	39	41.76
December	58	23	38.25	45	38	42.03
1893.						
January	46	25	33.61	45	41	42.70
February	45	22	37.32	46	39	42.64
March	52	26	40.51	48	43	45.12
April	58	32	43	47	41	45.73
May	65	40	51.35	51	46	48.74
June	66	47	55.06	57	48	52.6

FORT GASTON STATION, CALIFORNIA (LIVINGSTON STONE AND W. E. DOUGHERTY, CAPTAIN U. S. A., IN CHARGE).

This establishment was the first experiment in occupying a Government reservation on the west coast. Privileges granted by the Interior Department were continued, and the outlook for further good results is favorable. The water supply is unlimited and of finest quality. The building occupied combines hatchery and quarters for employees. Five ponds are employed in holding brood fish and as nurseries.

On the abandonment of the reservation for military purposes, July 1, 1892, supervision passed from Capt. Frank H. Edmunds, U. S. A., to Livingston Stone, superintendent of the Baird establishment, McCloud River, Mr. Stone remaining in charge until January, 1893. The Secretary of War was requested in December to permit Capt. William E. Dougherty, U. S. A., to resume supervision, and the request being granted, operations for the remaining half year were under his direction.

Fish brought over from the preceding fiscal year consisted of the following: Rainbow trout (brood fish), 300; rainbow trout (fry), 18,450; Von Behr trout (fry), 24,856; brook trout (fry), 9,854.

In July 15,000 rainbow-trout fry were liberated in local streams. On April 30, there were remaining on hand of Von Behr trout 12,000, and of brook trout 7,000. These were liberated in May, with the exception of 500 of the former and 400 of the latter, retained for brood stock. Those liberated were placed in the Supply, Mill, and Tishtang creeks, the number of Von Behr being 10,950, and the brook trout 6,193.

Quinnat salmon.—In August plans were inaugurated for the capture of adult salmon from the tributaries of Trinity River and from Redwood Creek, a dam and trap being constructed near the mouth of Mill Creek, a tributary of Trinity River, about 4 miles from the station. Traps were also constructed at Redwood and in Supply Creek, the latter being near the station. The limited amount of fishing on Redwood Creek, as a result of the absence of canneries on that stream, rendered it the most profitable source. Another trap in the vicinity, constructed by Indians, also furnished adult fish.

Salmon in this region ascend the streams for laying eggs twice a year, the first run occurring early in winter and the second late in spring. Eggs taken in the fall run amounted, by December 31, to 180,000, producing 117,000 fry for liberation in local waters February 23. Captures of adult fish were made to a limited extent in January and February, small numbers of eggs being taken.

In March and April 375,000 eggs were transferred from the auxiliary hatchery at Redwood to the station. Other consignments followed, which, together with those from traps on tributaries of Trinity River, furnished 540,000 fry for liberation in local streams in May and June.

Lieut. Commander J. J. Brice, U. S. N., in a report regarding the establishment of additional stations at Government reservations on

the west coast, makes the following reference to the spawning habits of salmon:

The conjunction of natural causes assisting salmon in all movements and in depositing eggs is as interesting as beautiful. In the operation of spawning, from my own observation, the salmon, on arriving at the place selected, remain quiet until recovered from the effects of the long journey from the sea, and for this purpose they select a pool where there is protection or concealment, under driftwood or overhanging bank. In pairs, male and female, they build nests, generally in the swift water on the ripple above or below the pool, the male guarding it with great jealousy, fighting away all intruders. The pool serves as a place of concealment during the day, the salmon spawning and making the nest at night or early in the morning, continuing during the day if the sky is overcast. The act of spawning may go on at intervals for a week before all the eggs are deposited. The construction of the nest is commenced by digging an elongated hole up and down stream, the fish using the snout and fins in making the excavation, throwing out sand and gravel in volumes. The stones and gravel are carried by the current below the excavation, forming a nest covering a space sometimes more than 6 feet in diameter, the small particles of sand and dirt being carried farther downstream. It seems strange that a collection of stone and pebbles should form a fish nest, yet nature has made it very simple, and secured results in a matter-of-fact way. The eggs are deposited in the hole by the female and impregnated by the male, the eggs clinging together in a mass and to the bottom, thirty to fifty minutes, at the end of which time they commence to separate. The gentle current sweeping through the trough-like hole carries each egg out of the excavation as it becomes detached from the mass and on to the nest of stones below, where it tumbles from one to another until it drops into one of the crevices, eventually finding its way to the bottom of the pile or nest, and there, lying securely hidden away, well protected from predatory fish, it finally hatches. It takes from forty to sixty days for the eggs to hatch, the time depending upon the temperature of water. After hatching the fish remain in the nest about twenty days, until the umbilical sac is exhausted, having during this time but one instinct, to hide and burrow deeper in the nest.

Steelhead salmon.—At the first haul of the seine in October a steelhead was caught, and subsequently 16 more were obtained from the Indian dam in the vicinity. These were placed in a small pond and held for the purpose of obtaining their eggs, but none was secured.

Rainbow trout.—In addition to the brood fish already on hand, 14 large specimens were obtained in October from a pond at the Indian agency. The eggs from these in March and April were sufficient to produce 100,000 fry, 20,000 of which were liberated in local waters in May, the remainder being carried over into the next fiscal year.

The mean temperature of the air in March was 43° F. and of the water 44°, in April 44.5° and 44.1°. The snow-fall was so great that on April 22 the snow was over 5 feet deep, hard packed, on the road where it crosses the mountains. The fishes remaining on hand at end of the fiscal year, June 30, 1893, are stated below:

Kind.	1893.	1892.	Brood fish.
Brook trout		400	
Von Behr trout		500	
Rainbow trout	80,000		250
Steelheads			20

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

Quinnat salmon eggs were obtained from the Clackamas and Sandy rivers, the latter stream being a new field. Alcoholic collections of eggs and fry were made and transmitted for the World's Fair.

At the opening of the fiscal year the building of a rack across the Clackamas for arresting the ascent of spawning salmon was well under way, the structure being completed July 7. The former barrier used consisted of two racks built on either side of an island, but this season the stream was closed on one side, the trap being located opposite. In the latter part of June and throughout July a growth of green moss, never before observed, was found on the bottom of the river, large quantities floating down during a period of five or six weeks, banking against the rack. Its removal required a great deal of labor. During the late summer boats were repaired and minor improvements made. In September the trap which formed a part of the rack was put in position, suitable inclosures built for holding the parent fish, and egg-collecting and hatching apparatus overhauled.

No salmon having appeared late in August, and it having been learned that they could not pass the sawmill dam at Gladstone, a tour was made to this point in company with Governor Pennoyer, the executive of the State of Oregon, the examination proving that there were no means of ascent. A fishway on this dam, owing to poor construction, was wholly ineffective. In compliance with Governor Pennoyer's request, the superintendent of the mill promised to erect a better fishway, but his promise was not fulfilled, and no fish would have passed the dam but for freshets, two of which occurred in October.

The first eggs from the Clackamas trap were taken September 20, collections being made each day thereafter until November 11, the number obtained amounting to 3,265,000. The greatest number taken in a single day was 132,000 on October 21; the smallest, 4,000 on November 11. Adult fish yielding eggs numbered 623. Male fish predominated, the exact number not being recorded. About 80 per cent of the eggs were obtained in October; 248,000 in September, 2,590,000 in October, and 427,000 in November.

Early in September two trips were made to the Sandy River, distant about 15 miles, a suitable location for a field station being found, both for an obstructing rack and water supply for developing eggs. Preparations were made for receiving and holding eggs, hatching-troughs being transported overland from the station. Water was obtained from a spring brook by means of a small dam and a wooden flume 150 feet long. Across the river a rack 175 feet long, with a trap below, was constructed. Employees were quartered in tents, all preparations being completed by September 20. The taking of eggs was commenced October 6, continuing thirty days, collections amounting to 1,179,000 from 253 fish. As soon as the eggs had developed sufficiently for eye-spots to be distinctly seen they were transferred to the station by wagon, in four loads, between November 17 and December 3, the losses sustained inci-

dent to transfer being small. About 20 per cent of eggs obtained here were unimpregnated, but the relative loss in the season's hatching was small. Could the rack have been placed earlier on the Sandy River it is believed that larger collections could have been made, the migration of fish having been in progress two months before completing the rack.

The liberation of fry was commenced December 29, continuing almost daily, as they developed, until April 20, deposits being made in the Clackamas River and in Clear Creek, a tributary. The young were scattered over an area of about 5 miles. In January the water temperature was very low, and as a result of ice formation in the troughs the flow was almost cut off. In the cold water the development of fry was retarded, and but few were released during the month. Those released in February amounted to about 1,000,000, in March to 1,500,000, and in April to about 1,000,000, the total reaching 4,100,000.

After the termination of the egg-collecting season the racks and inclosures on the Clackamas were removed and stored above the freshet line. From the commencement the pump was required to supply the hatchery, it being employed throughout November with the exception of three days. It was also used occasionally in December, but after December 21 there was, as a result of rainfall, sufficient brook water. On February 1 and 2 snow falling in the brook compelled constant attention to keep the water flowing. Once during February and again early in April Clear Creek was very high, floating one end of the bridge.

On February 7 there were received from Northville Station 20,000 eggs of brook trout. These arrived in good condition and hatched with slight loss, but the young began dying just before the sac was absorbed, all soon perishing. After March 31 the station force was reduced.

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

Both fresh-water and marine species were successfully maintained for purposes of study. Before the expiration of the fiscal year the superintendent was temporarily transferred to Chicago, where he was in immediate charge of the salt-water section of the aquaria maintained by the United States Fish Commission. The salt-water section at Chicago having proved relatively more successful than the fresh-water section, it is apparent that studies carried on at the aquaria in Washington brought about the result, the water in Chicago being circulated and aërated after the processes developed here.

In July, 1892, an experiment was made looking to the reduction of temperature in the aquaria by applying ice to the pipes in which salt water was circulated, but the consumption ran up to about 2,000 pounds per day, making the cost too great. No attempt has been made to reduce temperature by application of compressed air. The salt water being in circulation and subject to surrounding air temperature, reaches a high point in the warm months, attaining 88° in August. In winter it is also subject to low temperatures, which, however, are not so extreme, the surrounding air being tempered by means of artificial

heat from stoves. In December the temperature was 43°, and in January as low as 38° several days, in consequence of which the sheepshead, croakers, and spots were greatly affected, all of the first two kinds dying. Other species were unfavorably affected, but revived when the temperature rose to 50° and 60°.

In August the aquaria were repaired and put in condition for restocking on the advent of fall. Collections were obtained from Woods Hole, Quincy, Wytheville, and the Washington Fish Ponds, the steamer *Fish Hawk* contributing specimens of marine animals and plants and 800 gallons of sea water from the Chesapeake Bay. Salt-water collections were made at Fortress Monroe, Va.—water, animals, and plants. At that point an agent was employed periodically to make collections and hold in live-cars, when a messenger was sent to receive them. From Morehead City, N. C., February 22 to 28, there were obtained 22 spotted sea trout, 14 red drum, and a number of shellfish and plants, but the extremely cold winter had driven all other species beyond the reach of fishermen. The Potomac River, Accokeek Creek, Occoquan, and other local waters were drawn upon for fresh-water fishes. A trip to Fortress Monroe in July was unsuccessful owing to high temperature.

A fair degree of success was this year attained in holding the filefish, thorn-toads, and hermit-crabs, and by experiment it was found that sea-anemones could be successfully maintained in water oxygenized by the introduction of air jets. During the winter assistance was rendered the Commissioner in making his experimental tests of artificial and natural sea water in preparation for Chicago.

INVESTIGATIONS.

The appearance of a destructive parasite on young lake trout and landlocked salmon in June, 1893, is referred to under the Green Lake heading.

An inquiry, somewhat disappointing, but based on interesting statements, was made into the striped-bass fishery in the upper end of Albemarle Sound, with a view of ascertaining regular spawning-grounds. The New York fish commissioners have recently evinced a lively interest in the subject, the office being twice visited by Hon. L. D. Huntington, chairman, who expressed himself as anxious to take up the work, but scarcely able, on account of inadequate funds. In 1892 Mr. J. K. Rea, of Edenton, N. C., a fisherman of repute, operating the Williams fishery, a mile above Mackey Creek, caught in sturgeon nets of 11-inch mesh large numbers of striped bass, and while on a visit to Washington he informed a Fish Commission employee that over 100 of these fish were in spawning condition, the eggs freely running when the fish were taken into boats. The fish weighed from 50 to 75 pounds each, and being captured at a point favorable for railroad and other communication, the matter was deemed worthy of an investigation.

So far as known the only point where eggs can be obtained with anything like uniformity from season to season is on the upper waters of

the Roanoke, at Weldon, N. C., where supplies are limited. The Williams fishery being situated immediately below and in the influence of this river, where it enters Albemarle Sound, caused reasonable hope that something of value might be learned. Accordingly a visit was made to the scene, two days being spent there, April 29 and 30. Inquiry developed the fact that 60 per cent of the sales by J. K. Rea, operating there, were striped bass, and he was this year fishing 15 pound nets, 4 sturgeon gill nets, and 1,500 yards of shad gill nets. Provisional arrangements were effected for obtaining the spare room in Mr. Rea's buildings, his nets, boats, and his personal cooperation for the nominal sum of $1 per day, all fish stripped in obtaining eggs to be paid for at the rate of $1 each, to cover damage sustained. Recommendations being approved, on May 8 Mr. J. L. Leary, a former citizen of Edenton, who had operated nets in that region and was acquainted with the people and surroundings, was engaged to examine the fish taken. From Washington he took 50 jars, the necessary piping, and a hand pump, in order to subject a part of all lots secured to the hatching test. Within two days after arrival an annex to the fish-house, 9 by 29 feet, containing hatching equipment, was completed. Three stands intended for salting fish were connected with piping, forming a tank of 300 gallons capacity, and it was found that one person could in 20 minutes easily pump up a supply more than ample to run the 50 jars for an hour.

Within two days the fishermen were confronted with a disastrous freshet from the Roanoke, the worst seen in ten years, the sound water being thick for miles, and covered with saw logs, railroad ties, and trees. As a result all fishing operations in that area were suspended for a week, shad and herring disappearing by May 20, none having been caught throughout the entire week in ten pound nets. The weather became so cold that frost was barely escaped. From May 13, however, and every day after, the nets were examined, sometimes twice a day. The total number of bass caught consisted of 182 males and 10 females, none of the latter being in spawning condition. The weight of fish was from 2 to 8 pounds, males and females, with the exception of one female weighing 50 pounds. Of those caught, 75 were taken between May 28 and 31. Not only were Mr. Rea's nets constantly looked after, but communication was kept up with a number of other fishermen, and inquiry developed the fact that but few bass were anywhere taken in the sound after the muddy water arrived. The sturgeon fishery, which in 1892 was inaugurated on April 8, was not commenced this year until April 20. A trustworthy report was received that Captain Hettrick, the introducer of the pound net in the Albemarle region, fishing some miles below, took on April 15 a large striped bass which was spawning.

Reference to Mr. J. K. Rea's book established the fact that it was between April 10 and 18, 1892, that the bulk of large spawning fish referred to were taken. On June 20 two ovaries in dry salt were forwarded from Edenton, one from a 72-pound fish and the other from a 60-pound fish. The roe of the larger weighed 21¾ pounds. These were

obtained from Mr. W. D. Rea, of Edenton, who had captured the fish between April 15 and 20.

On June 9, fishing operations being concluded, the equipment was returned. The Commission is indebted to Messrs. J. K. Rea & Bros. for courtesies. As these parties are on the lookout for a recurrence of schools of spawning fish it is believed that data may yet be obtained as a result of the inquiry.

DISTRIBUTION.

In addition to the regular work of distribution, the special cars were more or less engaged in transferring live material, marine and fresh-water, to the World's Fair, Chicago, Ill., for fish-cultural and aquarial exhibits made by the United States Fish Commission. In obtaining this material the several stations of the Commission and the steamer *Fish Hawk* were drawn upon, salt-water specimens being secured on the Atlantic, Gulf, and Pacific coasts. The special cars, each having a crew of 5 men, were as follows: Car No. 1, T. C. Pearce in charge; No. 2, G. H. Lambson in charge; No. 3, R. S. Johnson in charge; No. 4, F. P. Hagen and F. C. James in charge.

During the year the car service was enlarged in efficiency by the purchase of a new baggage car, afterwards equipped with a special view to the character of work to be performed. The demand for this increase arose from the fact that there had been a large growth in the number of hatching-stations, while transportation facilities had remained the same. Car No. 4 was purchased from the Harlan & Hollingsworth Company, Wilmington, Del., March 1, 1893; its length is 55 feet 7 inches, its width 9 feet 9 inches. Its entire cost with the special equipment was about $4,500. It was fitted with new approved couplers, conforming to regulations of the railway service. The special equipment for moving fishes consisted of four cedar tanks, each 4 feet in diameter, and two others of the same material 8 feet in diameter, all being about 2 feet in depth. These tanks were bolted to the bottom of the car, and provided, at first, with canvas covers to prevent the wasting of water and undue agitation from which fish would receive injuries. Subsequently the canvas was removed and in place of it gratings of wood provided. The gratings were made with narrow openings about one-fourth inch wide, and were held in position by wedges supported on cleats. When the tanks were filled the surface water was just even with upper surface of gratings. By means of this appliance the water was not only restrained from wasting and from violent agitation, but was also aërated. After the tanks had been placed in position they were sterilized by means of steam.

The steam plant consisted of an upright boiler and duplex air pump, the latter from the New York Air Brake Company. The aëration of water in the tanks was effected by air circulation, the first application to the transportation service, derived from the air pump and introduced into tanks by means of rubber tubing attached to iron piping. The separation of the air current into minute bubbles was effected by forcing

through wooden plugs of the American linden tree, inserted a few inches apart in rubber tubing. In addition to appliances already mentioned, sleeping berths of a temporary character were provided for the crew, cooking arrangements also being made.

The fish commissioners of New York having presented 100,000 muskellunge to the commissioners of California, and the latter authorities not being able to provide for the transportation, they sought the assistance of the United States Fish Commission, and on May 25 the fry were taken on board car No. 2, at Bemus Point, N. Y. The trip was highly successful, the loss in transit being estimated at only 9,000. Those which survived were deposited in Lake Merced and Lake Pilarcitos, California, 60,000 in the former and 31,000 in the latter, May 31. The first named were liberated at Ocean View, San Mateo County, Cal., the latter at Millbræ, in the same county.

The scope of the distribution service for the year and the details of the distribution of fishes are shown in the following tables:

Summary showing names of railroads and total number of miles of free transportation furnished the United States Fish Commission cars and messengers during the fiscal year ending June 30, 1893.

Name of railroad.	Cars.	Messengers.	Total.
Atchison, Topeka and Santa Fe	5,727	1,104	6,831
Baltimore and Ohio	513	632	1,145
Baltimore and Ohio Southwestern	90	.....	90
Burlington, Cedar Rapids and Northern	2,923	78	3,001
Chesapeake and Ohio	8,136	220	8,356
Chicago, Burlington and Quincy	7,614	644	8,258
Chicago and Northwestern	882	.....	882
Chicago, St. Paul, Minneapolis and Omaha	64	.....	64
Cleveland, Cincinnati, Chicago and St. Louis	6,806	.....	6,806
Colorado Midland	540	125	665
Delaware and Hudson	234	202	436
Denver and Rio Grande	.....	2,259	2,259
Duluth and Iron Range	.....	374	374
Duluth, South Shore and Atlantic	266	.....	266
Flint and Pere Marquette	1,452	29	1,481
Fremont, Elkhorn and Missouri Valley	824	272	1,096
Grand Rapids and Indiana	935	.....	935
Great Northern	342	.....	342
International and Great Northern	26	.....	26
Jacksonville Southeastern	545	.....	545
Kansas City, Fort Scott and Memphis	1,010	46	1,056
Kansas City, Fort Smith and Southern	38	380	418
Kentucky Central	192	.....	192
Louisville and Nashville	546	9	555
Michigan Central	12,021	279	12,300
Minneapolis, St. Paul and Sault Ste. Marie	213	.....	213
Missouri, Kansas and Texas	406	.....	406
Missouri Pacific	1,347	.....	1,347
Mobile and Ohio	466	.....	466
Montana Union	.....	32	32
Nashville, Chattanooga and St. Louis	98	.....	98
New York, Lake Erie and Western	296	.....	296
Northern Pacific	4,112	1,370	5,482
Pennsylvania Railroad	54	.....	54
Southern Pacific	2,074	.....	2,074
Spokane Falls and Northern	80	.....	80
St. Louis and San Francisco	1,786	752	2,538
St. Louis Southwestern	212	.....	212
Terre Haute and Indianapolis	634	.....	634
Texas Pacific	1,465	.....	1,465
Union Pacific	13,249	4,253	17,502
Wabash	4,072	112	4,184
West Virginia and Pittsburg	.....	200	200
Wilmington and Northern	.....	15	15
Wisconsin Central	1,626	.....	1,626
Zanesville and Ohio	52	.....	52
	83,968	13,393	97,361

Statement of mileage by cars, detached messengers, and species.

Kind of fish, etc.	Transferred by—	Number of miles traveled.		
		Paid.	Free.	Total.
Native food-fishes	Car 1	1,567	6,446	
	Car 2	2,641	15,108	48,250
	Car 3	3,771	15,338	
	Detached messenger	2,444	935	
Trout	Car 1	361		
	Car 2	2,287	10,212	56,191
	Car 3	7,619	4,492	
	Detached messenger	20,980	10,240	
Carp	Car 1	5,188	4,917	12,117
	Detached messenger	1,902	110	
Pike perch	Car 1	1,052	398	
	Car 2	666	540	2,935
	Detached messenger	279		
Shad	Car 3	2,542		12,513
	Detached messenger	9,971		
World's Fair	Car 1	3,134	5,943	
	Car 2	3,994	5,896	
	Car 3	3,362	4,818	44,842
	Car 4	4,812	9,860	
	Detached messenger	2,872	151	
Miscellaneous	Car 1	222		
	Car 2	222		
	Car 3	410		12,610
	Car 4	222		
	Detached messenger	9,577	1,957	
Total		92,097	97,361	189,458

Details of distribution.

Disposition.	Eggs.	Fry.	Adults and yearling.
Spotted catfish (*Ictalurus punctatus*):			
Arizona Fish Commission			722
Applicants in District of Columbia			5
Illinois			383
Chicago, Burlington and Quincy Company's ponds, near Galesburg, Ill.			325
Lake Bartlett, near Waterloo, Ill.			150
Applicants in Indiana			100
Lake Wawassee, near Cedar Beach, Ind			125
Pine Lake, near Laporte, Ind			230
Upper Iowa River, near Decorah, Iowa			200
Turkey River, near Cresco, Iowa			90
Wapsipinicon River, near Independence, Iowa			50
Cedar River, near Cedar Rapids, Iowa			500
Waterloo, Iowa			500
Spirit Lake, near Spirit Lake, Iowa			258
Reservoir near Creston, Iowa			147
Applicants in Kansas			360
Kentucky			120
Lake Mingo, near Nicholasville, Ky			100
Nolan and Valley creeks, near Glendale, Ky			50
Streams near Hagerstown, Md			300
Little Clam Lake, near Cadillac, Mich			300
Big Clam Lake, near Cadillac, Mich			307
Applicants in Missouri			1,050
New Mexico			225
Ohio			25
Bass Lake, near Chardon, Ohio			75
Mahoning River, near Leavittsburg, Ohio			60
Applicants in Pennsylvania			50
French Creek, near Rapid City, S. Dak			200
White Clay and Porcupine creeks, on Pine Ridge Indian Agency, S. Dak			445
Beaver Creek, near Huntingdon, Tenn			150
Applicants in Virginia			400
Jackson River, near Cedar River, Virginia			94
Craig Creek, near New Castle, Va			75
Applicants in Washington			125
Clear Lake, near Clear Lake, Wash			75
Deer Lake, near Loon Lake, Wash			50
Chain of Lakes near Waupaca, Wis			65
Carp (*Cyprinus carpio*):			
Applicants in Alabama			1,340
Arizona			1,301
Arkansas			1,080
Colorado			136
Connecticut			131

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Carp (*Cyprinus carpio*)—Continued.			
Applicants in Delaware			30
Delaware Fish Commission			1,400
Applicants in District of Columbia			300
Florida			1,018
Georgia			1,545
Georgia Fish Commission			2,000
Appalachee River, near Farmington, Ga			1,000
Oconee River, near Mount Vernon, Ga			500
Watkinsville, Ga			500
Savannah River, near Augusta, Ga			1,000
Yellow River, near Covington, Ga			1,000
Applicants in Idaho			493
Illinois			372
Indiana			218
Indian Territory			103
Iowa			453
Kansas			767
Kentucky			130
Cumberland River, near Pineville, Ky			2,000
Applicants in Louisiana			105
Maine			150
Maryland			387
Maryland Fish Commission			1,030
Applicants in Massachusetts			200
Michigan			102
Minnesota			118
Minnesota Fish Commission			1,500
Applicants in Mississippi			136
Missouri			628
Montana			321
New Hampshire			30
New Jersey			120
New Mexico			360
New York			2,530
North Carolina			1,844
Neuse River, near Goldsboro, N. C			3,936
Newbern, N. C			1,592
Roanoke River, near Weldon, N. C			3,936
Trent River, near Newbern, N. C			2,344
Applicants in North Dakota			900
Ohio			545
Oklahoma			373
Oregon			6
Pennsylvania			1,108
Rhode Island			30
South Carolina			558
South Dakota			608
Streams on Pine Ridge Indian Reservation, S. Dak			4,900
Applicants in Tennessee			344
Texas			939
Utah			3,130
Virginia			2,744
James River, near Richmond, Va			3,936
Applicants in Washington			225
West Virginia			200
West Virginia Fish Commission			1,000
Applicants in Wisconsin			410
Wisconsin Fish Commission			10,000
Applicants in Wyoming			30
Ontario Fish Commission, Canada			300
Tench (*Tinca tinca*):			
Applicants in Arkansas			300
Delaware Fish Commission			300
Applicants in Missouri			25
Missouri Fish Commission			5,000
Meramec River at crossing of St. L. and S. F. Rwy., Mo			6,430
Applicants in Mississippi			100
Colorado River, near Austin, Tex			1,500
San Marcos River, near San Marcos, Tex			1,500
Golden ide (*Idus melanotus*):			
Applicants in Missouri			10
New York			100
North Carolina			10
Goldfish (*Carassius auratus*):			
Applicants in Alabama			76
Arkansas			171
Colorado			43
Connecticut			37
Delaware			76
District of Columbia			2,146
Florida			100
Georgia			202
Idaho			4

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Goldfish (*Carassius auratus*)—Continued.			
Applicants in Illinois			742
Indiana			133
Indian Territory			40
Iowa			159
Kansas			456
Kentucky			121
Louisiana			148
Maine			8
Massachusetts			139
Michigan			113
Minnesota			52
Mississippi			68
Missouri			1,723
Nebraska			24
New Hampshire			14
New Jersey			183
New York			523
North Carolina			272
Ohio			598
Oklahoma			4
Pennsylvania			1,114
Rhode Island			8
South Carolina			95
South Dakota			28
Tennessee			350
Texas			60
Utah			90
Virginia			2,280
Washington			4
West Virginia			154
Wisconsin			30
Shad (*Clupea sapidissima*).			
United States Fish Commission ponds, Washington, D. C.		[a](1,444,000)	
Brandywine Creek, Wilmington, Del.		2,237,000	
Nanticoke River, Seaford, Del.		870,000	
Patapsco River, Relay station, Md.		215,000	
Patuxent River, Laurel, Md.		405,000	
Bush River, Bush River station, Md.		1,800,000	
North East River, North East, Md.		1,770,000	
Back River, Back River station, Md.		1,350,000	
Tuckahoe Creek, Queen Anne, Md.		900,000	
Elk River, Elkton, Md.		2,220,000	
Chester River, Chestertown, Md.		450,000	
Gunpowder River, Gunpowder station, Md.		1,800,000	
Wicomico River, Salisbury, Md.		840,000	
Grand Pond, near Norfolk, Mass.		350,000	
Taunton River, near Taunton, Mass.		988,000	
Hearrels Branch, tributary to Shoal Creek, tributary to Spring River, tributary to Neosho River, Missouri			[b] 200,000
Delaware River, Port Jervis, N. Y.		900,000	
Callicoon, N. Y.		450,000	
Delaware Water Gap, Pa.		1,720,000	
Lackawaxen, Pa.		750,000	
Timber Creek, near Gloucester, N. J.		744,000	
Dividing Creek, Dividing Creek, N. J.		776,000	
Neuse River, Goldsboro, N. C.		252,500	
Branch of Cape Fear River, near Wallace, N. C.		252,000	
Lumber River, near Lumberton, N. C.		336,000	
Susquehanna River, near Battery Island, Md.		7,224,000	
Port Deposit, Md.		3,650,000	
Columbia, Pa.		1,761,000	
Fites Eddy, Pa.		1,770,000	
Peach Bottom, Pa.		1,800,000	
Hudson River, near Athens, N. Y.		1,573,000	
Congaree River, near Columbia, S. C.		1,660,500	
Chappawansic Creek, Quantico, Va.		317,000	
Nealsco Creek, Freestone, Va.		97,000	
Mattapony River, near Milford, Va.		335,000	
Stony Creek, Stony Creek station, Va.		338,000	
Rapidan River, Rapidan, Va.		400,000	
Otter River, Evington, Va.		292,000	
Rappahannock River, Fredericksburg, Va.		500,000	
Cedar River, Catlett, Va.		428,000	
Potomac River, Washington, D. C.			[c] 600,000

[a] Deposited for rearing and distribution in fall of 1893.

[b] Estimated product of 700,000 fry deposited in rearing-ponds at United States Fish Commission Station, Neosho, Mo.

[c] Estimated product of 1,080,000 fry deposited in rearing-ponds of the United States Fish Commission at Washington, D. C.

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Quinnat salmon (*Oncorhynchus chouicha*):			
California Fish Commission	3,530,000		
McCloud River, near Baird, Cal		533,100	
Redwood Creek, near Baird Ranch, Cal		170,000	
Trinity River, Fort Gaston, Cal		487,200	
Clackamas River, near Clackamas, Oreg		4,100,000	
Atlantic salmon (*Salmo salar*):			
Connecticut Fish Commission	108,000		
New York Fish Commission	75,000		
New Hampshire Fish Commission	50,000		
Alamoosook Lake, near Craig Brook, Me			1,448
Landlocked salmon (*Salmo salar* var. *sebago*):			
Commodore Club, Hartland, Me			999
Green Lake, in Hancock County, Me			500
Toddy Pond, near Orland, Me			16,032
Grand Lake and Grand Lake Stream, in Washington County, Me			48,000
Loch Leven trout (*Salmo levenensis*):			
E. A. Adams, Boston, Mass	20,000		
Geo. M. Brown, for F. and P. M. Rwy. Co., Saginaw, Mich	25,000		
Minnesota Fish Commission	20,000		
New Hampshire Fish Commission	15,000		
Prof. C. Sasaki, Tokyo, Japan	10,000		
W. P. Greenough, La Chévrotière, Quebec, Canada	10,000		
Lester River, near Duluth, Minn			1,550
Ohio Fish Commission			3,350
Applicants in Wyoming			2,600
Rainbow trout (*Salmo irideus*):			
Maryland Fish Commission	46,500		
Minnesota Fish Commission	20,000		
Missouri Fish Commission	20,000		
Nebraska Fish Commission	37,500		
G. W. Thayer, Provo City, Utah	10,000		
Vermont Fish Commission	81,000		
John H. Gordon, South Bend, Wyo	10,000		
C. Raveret-Wattel, Fécamp, Seine Inférieure, France	10,000		
Prof. C. Sasaki, Tokyo, Japan	10,000		
Emil Warner, Swiss consul, Havre, France, for the Government of Switzerland	30,000		
Trinity River, near Fort Gaston, Cal		35,000	
Applicants in District of Columbia		2,000	
Maryland		2,000	
Walker Run, near Hagerstown, Md		16,500	
Lake Erie, near Put-in Bay, Ohio		65,000	
Warner Mill Creek, near Chanceford, Pa		16,500	
Applicants in Virginia		2,000	
Sandy River, near McGregor, Minn		20,000	
Partridge River, near Okwanim, Minn		20,000	
St. Croix River, near Gordon, Wis		23,000	
White River, near Mason, Wis		20,000	
Applicants in Alabama			650
Arkansas			100
Crystal Lake, near Eureka Springs, Ark			1,000
Mine Creek, near Nashville, Ark			800
Black Fish Lake, in St. Francis County, Ark			500
Silver Springs, near Rogers, Ark			500
Lower Evergreen Lake, in Lake County, Colo			1,550
Applicants in District of Columbia			500
Georgia			3,100
Illinois			375
Bloody Run, near McGregor, Iowa			150
Des Moines River, near Ottumwa, Iowa			600
Des Moines, Iowa			100
Mississippi River, near Dubuque, Iowa			175
Applicants in Kansas			475
Strangers Creek, near Atchison, Kans			350
Deer Creek, near Atchison, Kans			150
Crane Creek, near London, Ky			500
Applicants in Louisiana			225
Maryland			1,883
Bennett Creek, near Frederick, Md			500
Ballenger Creek, near Frederick, Md			240
First and Second Mine runs, near Towson, Md			1,000
Walker Run, near Hagerstown, Md			500
Shoemaker and Silver runs, near Brooklandville, Md			1,200
Seven Brooks, near Glyndon, Md			1,000
Applicants in Missouri			3,550
Current River, near Chilton, Mo			9,891
Shoal Creek, near Neosho, Mo			2,316
Exeter, Mo			400
Granby, Mo			600
Barbee Lake, near Ritchey, Mo			1,100
Indian Creek, near Eagle Mills, Mo			600

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Rainbow trout (*Salmo irideus*)—Continued.			
Indian Creek, near Lanagan, Mo			1,945
South Fork of Buffalo River, near Pratts Place, Mo			600
Baynham Branch, near Neosho, Mo			500
Hickory Creek, near Neosho, Mo			500
Big Lost Creek, near Racine, Mo			600
Elk River, near Pineville, Mo			600
Rutledge, Mo			600
South Fork of Elkhorn River, near Indian Springs, Mo			600
Crane Creek, near Crane, Mo			600
Missouri Fish Commission			18
Applicants in New Jersey			1,300
Stony Creek, near Delaware, N. J			1,000
Raritan River, near Trenton, N. J			1,000
Applicants in New York			600
Wiscoy Creek, near Bliss, N. Y			800
Applicants in North Carolina			350
Flat Creek, near Black Mountain, N. C			1,500
Broad River, near Black Mountain, N. C			1,000
Honing Creek, near Asheville, N. C			986
Toms Creek, near Marion, N. C			985
Public streams near Linville, N. C			1,000
Applicants in Pennsylvania			7,175
Hawkes Pond, near Scranton, Pa			600
Mountain Branch, near Houtzdale, Pa			1,000
Cabin Branch, near York, Pa			400
Cold Spring Brook, near Susquehanna, Pa			200
Streams near Jermyn, Pa			500
Falling Springs, near Chambersburg, Pa			2,200
Big Springs, near Florin, Pa			1,000
Dennis Run, near Coatesville, Pa			100
Steen Run, near Coatesville, Pa			100
Alder Run, near Kylertown, Pa			1,000
Morgan Run, near Clearfield, Pa			1,100
Youngs Run, near Coatesville, Pa			100
Cook Run, near Coatesville, Pa			100
Powell Run, near Coatesville, Pa			100
Long Run, near Gaines, Pa			436
Elk Creek, near Toughkenamon, Pa			500
Starrucca Creek, near Susquehanna, Pa			600
Brandt, Pa			400
Black Lick Creek, near Conemaugh, Pa			800
Lackawanna Creek, near Burnwood, Pa			200
Beaver Creek, near East Hickory, Pa			500
Canawasto Creek, near Susquehanna, Pa			200
White Deer Creek, near Milton, Pa			800
Hemlock Creek, near Brandt, Pa			200
Wild Cat Creek, near Brandt, Pa			200
Tunkhannock Creek, near Susquehanna, Pa			600
Pickering Creek, near Phœnixville, Pa			200
Lamb Creek, near Mansfield, Pa			700
Big Roaring Creek, near Shamokin, Pa			1,000
Ridley Creek, near Chester, Pa			300
Nanon Creek, near Du Bois, Pa			300
Mill Creek, near Tioga, Pa			700
Haller Creek, near Richland, Pa			300
Harvey Creek, near Nanticoke, Pa			600
West Branch of Susquehanna, near Lock Haven, Pa			500
Susquehanna River, near Driftwood, Pa			600
Allegheny River, near Coudersport, Pa			600
Black Lick River, near Ebensburg, Pa			1,000
Applicants in South Carolina			200
Long Cane Creek, near Abbeville, S. C			1,000
Cullasoga River, near Walhalla, S. C			600
Applicants in Tennessee			400
Piney River, near Spring City, Tenn			200
Doe River, near Roan Station, Tenn			750
Public streams, near Johnson City, Tenn			800
Applicants in Texas			256
Cypress Bayou, near Jefferson, Tex			400
Otter Creek, near Rutland, Vt			1,401
Mill Creek, near Middleway, W. Va			1,000
Cheat River, near Cheat Bridge, W. Va			1,560
Little and Big Plow rivers, near Stevens Point, Wis			2,100
Applicants in Virginia			4,050
Algoma Lake, near Howardsville, Va			400
Bold Brook, near Louisa, Va			400
South Fork and Roaring Branch, near Big Stone Gap, Va			1,000
Pinkley Branch, near Wytheville, Va			200
Bens Run, near Boyce, Va			300
Laurel Run, near Lexington, Va			600
Cameron and Four Mile runs, near Four Mile Run, Va			275
Mountain streams near Greenwood Depot, Va			600

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Rainbow trout (*Salmo irideus*)—Continued.			
Mountain streams near Cleveland, Va			800
Stony Creek, near Liberty Furnace, Va			600
Calhoun Creek, near Big Stone Gap, Va			1,000
Hawksbill Creek, near Luray, Va			400
Goose and Cocoeton creeks, near Clark Gap, Va			500
Barbour Creek, near Craig City, Va			1,000
Mill Creek, near Craig City, Va			1,000
Healing Creek, near Hot Springs, Va			500
Falling Spring Creek, near Hot Springs, Va			970
Jackson River, near Hot Springs, Va			960
Piney River, near Culpeper, Va			1,000
New River, near Point Pleasant, Va			200
Cow Pasture River, near Millboro, Va			1,500
Catawba River, near Fincastle, Va			800
Von Behr trout (*Salmo fario*):			
Connecticut Fish Commission	20,000		
Maryland Fish Commission	35,000		
Minnesota Fish Commission	20,000		
Nebraska Fish Commission	20,000		
New Hampshire Fish Commission	25,000		
Vermont Fish Commission	20,000		
Otto Gramm, Laramie, Wyo	15,000		
Prof. C. Sasaki, Tokyo, Japan	10,000		
W. P. Greenough, La Chévrotière, Quebec, Canada	10,000		
Redwood Creek, in Humboldt County, Cal			178
Three creeks, in Humboldt County, Cal			50
Supply Mill and Fish Tang creeks, near Hoopa Valley, Cal			10,700
Uneva Lake, in Summit County, Colo			2,500
Wellington Lake, near Buffalo, Colo			2,000
Twin Lakes, near Twin Lakes, Colo			2,000
St. Vrain River, near Lyons, Colo			1,000
Deer Creek, near Baily, Park County, Colo			3,950
Boulder Creek, near Boulder, Colo			4,000
Rock Creek, in Lake County, Colo			2,500
Fryingpan Creek, in Pitkin County, Colo			2,000
Arkansas River, near Salida, Colo			2,000
Lake Park, in Lake County, Colo			1,500
Applicants in Idaho			300
Maine			500
Massachusetts			300
Michigan			150
Nebraska Fish Commission			6,000
South Branch, near Trenton, N. J			993
Demorest Creek, near Congers, N. Y			1,000
Analomink Creek, near Delaware Water Gap, Pa			1,000
Applicants in Texas			200
Applicants in Vermont			1,000
Otter Creek, near Proctor, Vt			2,500
Vermont Fish Commission			2,500
Black-spotted trout (*Salmo mykiss*):			
Wyoming Fish Commission	25,000		
Otto Gramm, Laramie, Wyo	5,000		
H. M. Orahood, Buffalo Creek, Colo	30,000		
Applicants in Colorado			1,000
Wellington Lake, near Buffalo, Colo			2,000
Twin Lakes, near Snowden, Colo			7,000
Mammoth Creek and Lake, near Central City, Colo			7,000
Michigan Creek, near Jefferson, Colo			1,000
Grizzly Creek, near Glenwood, Colo			1,000
Deer Creek, near Baily, Colo			2,000
Arkansas River, near Salida, Colo			2,000
Lower Evergreen Lakes, in Lake County, Colo			500
Minnesota Fish Commission			1,000
Sun River, near Great Falls, Mont			5,000
Belt Creek, near Goodman, Mont			1,000
Little Sheep Creek, near Lima, Mont			2,000
Humboldt River, near Elko, Nev			4,925
Wisconsin Fish Commission			3,600
Applicants in Wyoming			5,000
Brook trout (*Salvelinus fontinalis*):			
Troutdale Fish Farm Co., Mammoth Springs, Ark	5,000		
Flint and Pere Marquette R. R. Co., per G. M. Brown, Saginaw, Mich	25,000		
Minnesota Fish Commission	20,000		
Oregon Fish Commission	20,000		
Vermont Fish Commission	20,000		
Applicants in Colorado			2,500
Uneva Lake, in Summit County, Colo			2,500
Wellington Lake, near Buffalo, Colo			2,000
Lake Edith, near Idaho Springs, Colo			5,500

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Brook trout (*Salvelinus fontinalis*)—Continued.			
Twin Lakes, near Snowden, Colo			5,000
Mammoth Creek and Lake, near Central City, Colo			6,000
Lake Lenore, near Ouray, Colo			1,000
Texas Creek, near Cotopaxie, Colo			300
Grizzly Creek, near Glenwood, Colo			1,000
Clear Creek, near Georgetown, Colo			2,000
Boulder Creek, near Boulder, Colo			1,000
Greenhorn Creek, near Graneros, Colo			1,000
Fryingpan Creek, near Norrie, Colo			2,000
St. Vrain River, near Lyons, Colo			1,000
Arkansas River, near Salida, Colo			1,000
North Fork of South Platte River, in Jefferson Co., Colo			10,800
North Fork of North Platte River, near Walden, Colo			1,000
Park Lake, in Lake County, Colo			1,500
Rock Creek, in Lake County, Colo			2,500
South Platte River, in Park and Jefferson counties, Colo			5,000
Redwood Creek, in Humboldt County, Cal			215
Three Creeks, in Humboldt County, Cal			50
Supply Mill and Fish Tang creeks, near Hoopa Valley, Cal			5,900
Applicants in Indiana			800
Maine			500
Alamoosook Lake, near Orland, Me			27,564
Moose Pond, near Hartland, Me			1,970
Mill Brook, near North Amherst, Mass			500
Whately Brook, near Whately, Mass			200
Broad Brook, near Holyoke, Mass			300
Rush Creek, near Jenison, Mich			1,000
Clark Creek, near Grand Rapids, Mich			500
Indian Mill Creek, near Grand Rapids, Mich			500
Grand River, near Norvell, Mich			500
Brevoort Lake, near Moran, Mich			978
Silver Lake, near Quoto, Mich			300
Hickory Creek, in Newton County, Mo			900
Applicants in Missouri			100
Lake Leslie, near Elkhorn, Mont			2,000
Upper Elkhorn Creek, near Elkhorn, Mont			5,000
Goodman Creek, near Goodman, Mont			3,000
Lost Creek, near Anaconda, Mont			2,000
Little Sheep Creek, near Lima, Mont			4,000
Applicants in Nebraska			900
Otter Creek, near Ogallala, Nebr			5,000
Middle Loup River, near Halsey, Nebr			5,000
Nebraska Fish Commission			6,000
Applicants in New Hampshire			500
Small Brook, near Nashua, N. H			400
Santa Fe River, near Santa Fe, N. Mex			4,850
Musconetcong Creek, near Trenton, N. J			1,285
Lake View, near Bismarck, N. Dak			4,970
Deer Creek, near London, Ohio			800
Applicants in Pennsylvania			100
Meadow Brook, near Scranton, Pa			500
Rose Brook, near Honesdale, Pa			500
Tributaries of Dyberry Creek, near Honesdale, Pa			1,560
Little Dyberry Creek, near Honesdale, Pa			500
Lackawanna Creek, near Uniondale, Pa			973
Tobyhanna River, near Tobyhanna, Pa			800
Black Lick River, near Ebensburg, Pa			500
White River, near Hartford, Vt			1,000
Otter Creek, near Proctor, Vt			3,000
Beaver Creek near Proctor, Vt			1,200
Beechwood Lake, near Marinette, Wis			500
Miller and Barker creeks, near Barron, Wis			950
Hay Creek, near Marinette, Wis			500
Pokegama Creek, near Rice Lake, Wis			1,000
Menominee River, near Marinette, Wis			900
Green River, near Werley, Wis			725
Lake trout (*Salvelinus namaycush*):			
Connecticut Fish Commission	105,000		
Iowa Fish Commission	100,000		
Minnesota Fish Commission	100,000		
Nebraska Fish Commission	100,000		
New Hampshire Fish Commissioner	100,000		
New York Fish Commission	100,000		
Vermont Fish Commission	300,000		
Burt Lake, near Indian River, Mich		50,000	
Muskrat Lake, near Lake City, Mich		30,000	
Mullett Lake, near Topinabee, Mich		50,000	
Lake Erie, near North Bass Island reef, Ohio		81,500	
James Lake, near Angola, Ind		30,000	
Lake Kosciusko, near Syracuse, Ind		58,000	
Sylvan Lake, near Pontiac, Mich		20,000	
Lake Superior, near Lester Park, Minn		1,305,000	

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Lake trout (*Salvelinus namaycush*)—Continued.			
Lake Superior, near Grand Portage, Minn		100,000	
Fish Island, Minn		75,000	
Chicago Bay, Minn		50,000	
Two Harbor, Minn		50,000	
Beaver Bay, Minn		50,000	
Grand Marais, Minn		50,000	
Fisherman's Home, Mich		100,000	
Washington Harbor, Mich		100,000	
Wright Island, Mich		75,000	
Trout Lake, near Tower, Minn		100,000	
Eagle Nest Lake, near Ely, Minn		100,000	
Big McDonald Lake, near Perham, Minn		40,000	
Lake Sally, near Detroit, Minn		40,000	
Minnewaska Lake, near Glenwood, Minn		40,000	
Detroit Lake, near Detroit, Minn		40,000	
Battle Lake, near Battle Lake, Minn		40,000	
Clear Lake, near South Bend, Ind			1,000
Sawyer Lake, near Iron Mountain, Mich			1,000
Whitmore Lake, near Whitmore Lake, Mich			1,000
Mill Lake, near Wingleton, Mich			4,966
Trout Lake, near Trout Lake, Mich			3,955
Applicants in Pennsylvania			500
Glass Factory Pond, near Honesdale, Pa			1,480
Dun Pond, near Ararat, Pa			500
Elk Lake, near Honesdale, Pa			1,860
Harveys and Elk lakes, near Scranton, Pa			1,000
Fiddle Lake, near Ararat, Pa			500
Five-Mile Lake, near Poyntelle, Pa			500
Poyntelle Lake, near Poyntelle, Pa			490
Lake St. Croix, near Hudson, Wis			2,300
Rice Lake, near Rice Lake, Wis			1,950
Whitefish (*Coregonus clupeiformis*):			
New York State Fish Commission	5,000,000		
Lake Erie, near North Bass Island, Ohio		4,000,000	
Middle Bass Island, Ohio		4,400,000	
Ballast Island, Ohio		4,800,000	
Rattlesnake Island, Ohio		2,720,000	
Peach Point reefs, Ohio		3,000,000	
Kelley Island, Ohio		3,570,000	
Lake Michigan, near Manistique and Scott Point		1,000,000	
Epaufette and Warehouse Point		1,000,000	
Lake Huron, near Thunder Bay, Partridge Point, Mich		3,140,000	
Sturgeon Point		1,500,000	
East Tawas		1,500,000	
Miller Point		3,000,000	
Detour Passage, near Hay Point		2,000,000	
Whitefish Lake, near Corinne, Mich		2,000,000	
Straits of Mackinac, near Bois Blanc, Mich		1,500,000	
Lake Superior, near Duluth, Minn		2,982,000	
Wisconsin shore		6,000,000	
Tobin Bay, Mich		1,000,000	
Washington Harbor, Mich		500,000	
Lake herring (*Coregonus artedi*):			
Lake Erie, on the reefs of North Bass, Middle Bass, Ballast, Rattlesnake, and Kelley islands		6,505,000	
Yellow perch (*Perca flavescens*):			
Applicants in Illinois			325
Chicago, Burlington, and Quincy Company's pond, near Galesburg, Ill			110
North Fork Creek, near Danville, Ill			150
Sugar Creek, near Paris, Ill			185
Lake Maxinkuckee, near Marmont, Ind			385
Lake Wawassee, near Cedar Beach, Ind			257
Pine Lake, near Laporte, Ind			144
Applicants in Indiana			100
Upper Iowa River, near Decorah, Iowa			150
Wapsipinicon River, near Independence, Iowa			150
Cedar River, near Cedar Rapids, Iowa			900
Spirit Lake, near Spirit Lake, Iowa			200
Applicants in Kansas			50
Kentucky			150
Lake Mingo, near Nicholasville, Ky			50
Nolan and Valley creeks, near Glendale, Ky			186
Applicants in Missouri			50
New Mexico			25
Mohican Creek, near Lexington, Ohio			70
Mahoning River, near Leavittsville, Ohio			400
Long Lake, near Akron, Ohio			25
Mud Lake, near Hudson, Ohio			25
Tawawa Lake, near Sidney, Ohio			50
White, Clay, and Porcupine creeks, near Pine Ridge Indian Agency, S. Dak			41
Beaver Creek, near Huntingdon, Tenn			150

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Pike perch (*Stizostedion vitreum*):			
Pike River, in Minnesota	500,000		
Applicants in Illinois			166
Chain Lake, in St. Joseph County, Ind		200,000	
Chamberlain Lake, in St. Joseph County, Ind		200,000	
Riddle Lake, in St. Joseph County, Ind		200,000	
Clear Lake, in St. Joseph County, Ind		200,000	
Notre Dame Lake, in St. Joseph County, Ind		200,000	
Hudson Lake, in Laporte County, Ind		2,000,000	
Bear Lake, near Albion, Ind		200,000	
Private Lake, near Albion, Ind		300,000	
Lake Wawassee, near Cedar Beach, Ind			148
Pine Lake, near Laporte, Ind			31
Cedar River, near Waterloo, Iowa			300
Small lakes near Iron Mountain, Mich		500,000	
Poplar River, in Lake County, Minn		500,000	
Sandusky River and tributaries, near Upper Sandusky, Ohio		500,000	
Lake Erie, near Rattlesnake Island, Ohio		3,600,000	
Punderson Pond, near Burton, Ohio		500,000	
West Branch of Susquehanna River, in Clinton County, Pa		4,400,000	
West Branch of Susquehanna River, in Lycoming County, Pa		1,000,000	
Sinnemahoning Branch, in Cameron County, Pa		200,000	
Mouth of Bald Eagle Creek, in Clinton County, Pa		400,000	
Tennessee River, near Knoxville, Tenn		500,000	
Loudon, Tenn		400,000	
Clinch River and other streams, near Luttrell, Tenn		400,000	
Tennessee, Clinch, and Emory rivers, in Roane County, Tenn		500,000	
French Broad, Holston, and other streams, in Jefferson County, Tenn		500,000	
Little River, Little Tennessee River, and other streams, in Blount County, Tenn		500,000	
Powell River and other streams, in Campbell County, Tenn		500,000	
Clinch River and other streams, in Anderson County, Tenn		500,000	
Emory, Obeds, and other streams, in Morgan County, Tenn		300,000	
French Broad and Pigeon rivers, in Sevier County, Tenn		500,000	
New River and tributaries, in Scott County, Tenn		400,000	
Beaver Creek, near Huntingdon, Tenn			200
Lakes of the Wausaukee Club, near Amberg, Wis		500,000	
Lake Superior, near Superior Entry, Wis		4,000,000	
Sea bass (*Serranus atrarius*):			
Vineyard Sound, off Massachusetts coast		1,189,000	
White bass (*Roccus chrysops*):			
Applicants in Illinois			41
Chicago, Burlington and Quincy Company's pond, near Galesburg, Ill			30
Lake Wawassee, near Cedar Beach, Ind			250
Pine Lake, near Laporte, Ind			90
Upper Iowa River, near Decorah, Iowa			100
Maquoketa River, near Strawberry Point, Iowa			195
Turkey River, near Cresco, Iowa			200
Cedar River, near Waterloo, Iowa			500
Spirit Lake, near Spirit Lake, Iowa			75
Applicants in Kentucky			39
White Clay and Porcupine creeks, on Pine Ridge Indian Agency, S. Dak			40
Beaver Creek, near Huntingdon, Tenn			150
Black bass (*Micropterus dolomieu* and *M. salmoides*):			
Cook Creek, near Florence, Ala			200
Blackfish Lake, in St. Francis County, Ark			200
Arizona Fish Commission			138
Applicants in Arkansas			295
Colorado			600
Lake Saltonstall, near East Haven, Conn			200
Delaware Fish Commission			1,000
Brandywine Creek, near Wilmington, Del			480
Applicants in District of Columbia			850
Georgia			281
Boise River, near Boise, Idaho			1,597
Applicants in Illinois			845
Chicago, Burlington and Quincy Railroad Company's pond, near Galesburg, Ill			360
Graya Lake, near De Nices Lake, Ill			100
Deep Lake, near Lake Villa, Ill			100
Sni River, near East Hannibal, Ill			1,300
Island Lake, near Waterloo, Ill			616
Lake Bartlett, near Waterloo, Ill			325

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Black bass (*Micropterus dolomieu* and *M. salmoides*)—Cont'd.			
Schorr Lake, near Waterloo, Ill			325
North Fork Creek, near Danville, Ill			90
Applicants in Indiana			200
Lake Maxinkuckee, near Marmont, Ind			1,190
Lake Wawassee, near Cedar Beach, Ind			582
Pine Lake, near Laporte, Ind			100
Upper Iowa River, near Decorah, Iowa			200
Maquoketa River, near Strawberry Point, Iowa			385
Turkey River, near Cresco, Iowa			200
Wapsipinicon River, near Independence, Iowa			300
Cedar River, near Cedar Rapids, Iowa			1,400
Waterloo, Iowa			1,500
Spirit Lake, near Spirit Lake, Iowa			685
Reservoir near Cresco, Iowa			150
Applicants in Kansas			1,450
Walnut River, near Eldorado, Kans			200
Applicants in Kentucky			855
Lake Mingo, near Nicholasville, Ky			200
Nolan and Valley Creeks, near Glendale, Ky			177
Applicants in Louisiana			300
Maryland			1,088
Plank Ridge Run, near Leonardtown, Md			1,000
Potomac River above Great Falls, Md			400
below Great Falls, Md			500
Principio Creek, near Principio, Md			150
Patuxent River, near Laurel, Md			1,000
Piscataway Creek, near Stony Point, Md			1,000
Nine Mile Pond, near Springfield, Mass			640
Lake Brevoort, near Moran, Mich			300
Railroad Lake, near Wingleton, Mich			225
Mill Lake, near Wingleton, Mich			145
Little Clam Lake, near Cadillac, Mich			300
Big Clam Lake, near Cadillac, Mich			300
Applicants in Mississippi			275
Missouri			600
Indian Creek, near Neosho, Mo			118
Applicants in New Jersey			475
Overpeck Creek, near Leonia, N. J			120
Upper Millstone River, near Princeton, N. J			150
Applicants in New Mexico			1,980
New York			350
Honing Creek, near Asheville, N. C			65
Applicants in Ohio			550
Mahoning River, near Warren, Ohio			150
Muskingum River, near McConnellsville, Ohio			290
Mohican Creek, near Lexington, Ohio			250
Rocky Fork, near Hillsboro, Ohio			50
Bass Lake, near Chardon, Ohio			350
Punderson Lake, near Burton, Ohio			225
Long Lake, near Akron, Ohio			100
Mud Lake, near Hudson, Ohio			250
Tawawa Lake, near Sidney, Ohio			250
Willamette River, near Salem, Oregon			500
Applicants in Pennsylvania			1,425
Mauryp Dam, near Shenandoah, Pa			150
Loyalhanna Creek, near Latrobe, Pa			400
Kriders Dam, near Annville, Pa			300
Biedwell Pond, near Scranton, Pa			350
Brandywine Creek, near Chadds Ford, Pa			100
Branch of Brandywine Creek, near Honeybrook, Pa			400
Brandywine Creek, near Reading, Pa			480
Tioga River, near Tioga, Pa			150
Keeley Run, near Shenandoah, Va			400
Allegheny River, near Kittanning, Pa			200
West Branch of Susquehanna River, near Lock Haven, Pa			600
Susquehanna River, near Harrisburg, Pa			1,185
French Creek, near Rapid City, S. Dak			165
White, Clay, and Porcupine creeks, on Pine Ridge Indian Agency, S. Dak			400
Beaver Creek, near Huntingdon, Tenn			500
Private ponds in Texas			2,275
Cisco Water Company's Lake, near Cisco, Tex			110
Como Lake, near Fort Worth, Tex			100
Railroad reservoir, near Coal Mine Junction, Tex			100
Mill Pond, near Mineola, Tex			100
Cypress Bayou, near Jefferson, Tex			400
Applicants in Virginia			780
Broad Run, in Loudoun County, Va			1,000
Five-acre Lake, near Manassas, Va			300
Mountain streams, near Cleveland, Va			200
Powhick Creek, near Lorton Valley, Va			100
Aquia Creek, near Stafford Court-House, Va			200

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Black bass (*Micropterus dolomieu* and *M. salmoides*)—Cont'd.			
Walker Little Creek, near Pulaski City, Va			200
Goose Creek, in Loudoun County, Va			2,000
Occoquan River, near Woodbridge, Va			1,100
Appomattox River, near Blackstone, Va			100
Anna River, near Ashland, Va			100
North River, near Lexington, Va			400
South Fork of Holston River, near Marion, Va			500
Jackson River, near Cedar Creek, Va			1,200
Cow Pasture River, near Long Dale, Va			810
North River, near Goshen, Va			1,100
Craig Creek, near New Castle, Va			750
Occotink Creek, near Occotink, Va			1 000
Neapsico Creek, near Freestone, Va			1,000
Quantico Creek, near Quantico, Va			1,000
Reed Creek, near Wytheville, Va			908
Applicants in Washington			100
Gravelly Lake, near Lake View, Wash			550
Liberty Lake, near Spokane Falls, Wash			300
American Lake, near Tacoma, Wash			500
Clear Lake, near Clear Lake, Wash			300
Clear Lake, near Medical Lake, Wash			397
McDonald Lake, near Cedar Mountain, Wash			300
Deer Lake, near Loon Lake, Wash			700
Loon Lake, near Loon Lake, Wash			400
Applicants in West Virginia			400
Gauley River, near Camden, W. Va			1,992
Lake Geneva, near Lake Genova, Wis			1,695
Chain of Lakes, near Waupaca, Wis			1,285
Lake Beulah, near Lake Beulah, Wis			100
Crappie (*Pomoxis annularis* and *P. sparoides*):			
Arizona Fish Commission			249
Applicants in Colorado			100
Boise River, near Boise, Idaho			388
Applicants in Illinois			145
Chicago, Burlington and Quincy Company's ponds, near Galesburg, Ill			161
Snl River, near East Hannibal, Ill			500
North Fork Creek, near Danville, Ill			28
Lake Maxinkuckee, near Marmont, Ind			50
Lake Wawassee, near Cedar Beach, Ind			188
Pine Lake, near Laporte, Ind			150
Maquokota River, near Strawberry Point, Iowa			9
Cedar River, near Waterloo, Iowa			300
Spirit Lake, near Spirit Lake, Iowa			106
Reservoir near Creston, Iowa			200
Applicants in Kentucky			296
Lake Brevoort, near Moran, Mich			2,400
Little Clam Lake, near Cadillac, Mich			1,510
Big Clam Lake, near Cadillac, Mich			1,500
Applicants in Missouri			30
Ohio			50
Muskingum River, near McConnellsville, Ohio			400
Rocky Fork, near Hillsboro, Ohio			50
White, Clay, and Porcupine creeks, on Pine Ridge Indian Agency, S. Dak			80
Beaver Creek, near Huntingdon, Tenn			75
Jackson Creek, near Cedar Creek, Va			200
Cow Pasture River, near Long Dale, Va			230
North River, near Goshen, Va			305
Craig Creek, near New Castle, Va			100
Deer Lake, near Loon Lake, Wash			25
Chain of Lakes, near Waupaca, Wis			115
Warmouth bass (*Chænobryttus gulosus*):			
Arizona Fish Commission			628
Applicants in Idaho			300
Boise River, near Boise, Idaho			201
Applicants in Illinois			205
North Fork Creek, near Danville, Ill			300
Sugar Creek, near Paris, Ill			278
Snl River, near East Hannibal, Ill			500
Chicago, Burlington and Quincy Company's ponds, near Galesburg, Ill			60
Lake Wawassee, near Cedar Beach, Ind			10
Lake Maxinkuckee, near Marmont, Ind			400
Pine Lake, near Laporte, Ind			75
Applicants in Indiana			100
Cedar River, near Waterloo, Iowa			200
Reservoir near Creston, Iowa			100
Spirit Lake, near Spirit Lake, Iowa			247
Applicants in Kentucky			215
Lake Reba, near Richmond, Ky			50
Applicants in Missouri			60

Details of distribution—Continued.

Disposition.	Eggs.	Fry.	Adults and yearling.
Warmouth bass (*Chænobryttus gulosus*)—Continued.			
Muskingum River, near McConnellsville, Ohio			222
White, Clay, and Porcupine creeks, on Pine Ridge Indian Agency, S. Dak			65
Beaver Creek, near Huntingdon, Tenn			150
Shenandoah River, near Riverton, Va			202
Jackson River, near Cedar Creek, Va			100
Craig Creek, near New Castle, Va			107
Loon Lake, near Loon Lake, Wash			29
Chain of Lakes, near Waupaca, Wis			105
Rock bass (*Ambloplites rupestris*):			
Applicants in Alabama			1,400
District of Columbia			150
Georgia			50
Georgia Fish Commission			1,000
Applicants in Kansas			1,000
Lake Evelyn, near Bonner Springs, Kans			1,000
Mill Creek, near Alma, Kans			500
Lyons Creek, near Junction City, Kans			500
Winnescah Creek, near Pratt, Kans			500
Wild Cat Creek, near Manhattan, Kans			500
Cottonwood River, near Marion, Kans			500
Applicants in Kentucky			500
Maryland			300
Mississippi			50
Missouri			2,700
Osage River, near Schell, Mo			1,600
Applicants in New Jersey			500
North Carolina			1,100
Pennsylvania			1,700
Susquehanna River, near Milton, Pa			300
Applicants in Tennessee			1,150
Texas			260
Virginia			2,550
Local streams near Gladys, Va			300
South Mayo River, near Ridgeway, Va			350
Reed Creek, near Wytheville, Va			1,100
Sunfish (*Lepomis*, sp):			
Applicants in Illinois			556
Chicago, Burlington and Quincy Railroad Company's pond, near Galesburg, Ill			30
Pine Lake, near Laporte, Ind			200
Upper Iowa River, near Decorah, Iowa			32
Spirit Lake, near Spirit Lake, Iowa			190
Turkey River, near Cresco, Iowa			25
Applicants in Kansas			45
Kentucky			89
Missouri			100
Mohican Creek, near Lexington, Ohio			80
Tawawa Lake, near Sidney, Ohio			100
White, Clay, and Porcupine creeks, on Pine Ridge Indian Agency, S. Dak			31
Beaver Creek, near Huntingdon, Tenn			75
Deer Lake, near Loon Lake, Wash			9
Pickerel (*Lucius lucius*):			
Boise River, near Boise, Idaho			76
Beaver Creek, near Huntingdon, Tenn			25
Cod (*Gadus morrhua*):			
Massachusetts Bay, off Cape Ann, Mass	1,195,000	20,142,000	.....
Vineyard Sound, off Massachusetts coast	.....	850,500	.....
Mackerel (*Scomber scombrus*):			
Vineyard Sound, off Massachusetts coast	.....	434,500	.....
Flatfish (*Pseudopleuronectes americanus*):			
Vineyard Sound, off Massachusetts coast	.....	288,000	.....
Lobster (*Homarus americanus*):			
Vineyard Sound, off Massachusetts coast	.....	8,818,000	.....
Total	12,063,000	165,235,800	1,486,117

NOTE.—By request of the California Fish Commission, 100,000 muskellunge fry were received from the New York Fish Commission and transferred as follows: Lake Merced, near Ocean View, Cal., 60,000; Lake Pilarcitos, near Millbrae, Cal., 31,000.