XVII.—THE PROPAGATION AND DISTRIBUTION OF THE SHAD.

A—OPERATIONS IN THE DISTRIBUTION OF SHAD IN 1874.

By James W. Milner.

DISTRIBUTION FROM COEYMANS, N. Y.

The work of shad-distribution began the last week of June; the delay in the control of available funds preventing any possibility of propagation in the Potomac or rivers to the southward.

The services of experts were obtained at once for the season, and four traveling parties organized at Coeymans, N. Y., the station of the New York State commissioners.

The first shipment was made from this point on the 24th of June. Between this date and July 9, seven shipments were made to streams in the States of Ohio, Indiana, Illinois, and Texas. In all four hundred thousand shad were placed in tributaries of the great lakes, the Mississippi, and in the Brazos and Colorado Rivers of Texas.

DISTRIBUTION FROM SOUTH HADLEY FALLS, MASS.

The work of the New York commissioners ceased about the 3d of July, and the traveling parties moved to South Hadley Falls, Mass., the station of the Connecticut commissioners. Mr. Monroe A. Green had the direction of the work at its commencement here and during my absence of a fortnight in Texas and elsewhere.

Part of the plan at this station was to move a portion of the shad into the Connecticut above the fish-way. The generally accepted fact in the habits of anadromous fishes that they are disposed to return to almost the exact locality where they passed their embryonic and earlier stages of growth indicated a necessity for establishing a colony above the Holyoke dam.

There is a large amount of evidence to establish the fact of this habit in the salmon and alewife, and many fresh-water fishes seem to have as strong an instinct for locality as have the birds and mammals. It is tolerably evident that the shad possesses the same disposition to find its way back to familiar waters.

Observation of the shad brought to the large markets shows considerable difference in the physiognomy and general contour of those from different rivers. The suggestion is natural that they are distinct and separate colonies of the same species, and thus slight characteristics are perpetuated because they breed in-and-in and do not mix with those of

other rivers. If they have the instinct of locality to the degree that the salmon and alewife have, there would be likely to be little disposition in the shad of the Lower Connecticut to ascend the Holyoke dam. The Holyoke dam was erected in 1849. The present colony of shad in the Connecticut River can therefore have little of either inherited or developed instinct to extend their migrations above the foot of the dam.

As yet, no fish-way has proved to any large extent successful for shad. Their exceeding timidity is supposed to be the chief reason why they will not enter a fish-way. Even if this be the reason, no thorough test can be made until a colony has been established above the dam, because of the evidence there exists that they have no disposition to ascend higher than their familiar spawning-ground.

The proof of the success of a fish-way as a means of ascent for the shad to the upper waters of the rivers of the United States was regarded as a matter of considerable importance. A test at this well-constructed fish-way will probably afford all the evidence as to their desirability and their merits in deserving outlay where their purpose is principally for the ascent of shad. About 565,000 were placed above the dam, about one-half million being moved above Bellows Falls, in the State of Vermont. From this station, over two millions of young shad were sent to rivers in New England, the tributaries of the great lakes, Lake Champlain, and the Mississippi.

The German government during 1871 sent out Dr. Otto Finsch to examine into the fisheries and food-fishes of our waters, with reference, if possible, to a better development of the resources of their own waters. On his return he had strongly recommended the shad as above all other fishes the most important acquisition to Germany. This country is traversed by long rivers like the Rhine, the Weser, the Elbe, the Oder, and the Vistula. He was desirous, as a first experiment, that they should be introduced into the Weser.

The North German Lloyd Steamship Company, through their agents, Messrs. Oelrichs & Company, offered to transport the fish and attendants to Bremen, and return the attendants to New York, without charge. The friendly action of the German government in 1873 in their gift of 250,000 salmon-eggs prompted a ready compliance to this generous proposal, and 100,000 fish in charge of Fred Mather and A. A. Anderson were sent from Holyoke, Mass., and left on board of the steamer Donau, for Bremen, on the 5th of August. The steamer provided for the welfare of the fish a large clean tank containing an ample supply of Croton water. A convenient compartment on the deck contained the cans of fish swung in such a way that they were not endangered by the movements of the vessel.

Mr. Mather reports that continual care was given them and they remained in vigorous condition until the sixth day out, when they began to suffer.* A fog settling down over the surface of the sea increased the

*See Mather's report.

temperature until the mercury stood at 73° in the atmosphere. This seemed to lessen the vitality of the fish very fast, and at ten days out from land and within three days of the end of the voyage the last fish was dead.

An apparatus was devised by Mr. Mather with the intention of taking a quantity of partly-developed eggs, which would hatch when a few days out from land, and thereby limit the period of time the living fish would have to remain in the cans.

This apparatus was a large can, with a capacity of about twenty-five gallons; within it a cylinder having a wire-cloth bottom and a tight lid was adjusted, and within the cylinder the eggs were to be put. The cylinder had four arms soldered to it near the top, and the same number near the bottom. The ends of these arms had a solid rubber ball inserted. The ends of the arms with the rubber surface rested against the inside of the can, the friction sustaining the cylinder at any height in the can desired.

The plan was to fill the can to a convenient height with water, and it was thought the jolting of the railway-trains and possibly the roll of the steamer would be sufficient to give the eggs the necessary motion.

When leaving the river a quantity of eggs was put into the cylinder, but the wire-cloth used proved to be too coarse, and by the time the two miles between the river and the depot had been traversed the eggs had all worked through the meshes of the wire-cloth and were in the can below. It was, of course, useless to take the can farther.

It is due to those who had the experiment in charge to say that they were called on for the undertaking suddenly and unexpectedly, and that no time for experiment was afforded them before the start.

Omitting the shipment to Europe, I am able to report a very general success in the transfers of live shad.

The longest trip, that to Texas, suffered a loss in the quantity started with of 15 per cent. In most of the shipments the loss was very slight, not more than one or two per cent. A slightly larger loss was reported once or twice by men who had had little experience.

A very general appreciation of the effort was displayed in the regions benefited, and considerable enthusiasm shown wherever the people were at all informed in the matter of fish culture.

Tables are herewith appended showing the distribution of shad in 1874.

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

Date of transfer.	Place whence taken.	Period of journey.	Number of fish.		Introduction of fish.			Transfer in charge of—
			Originally taken.	Actually planted.	Place.	Stream.	Tributary of—	
		Hours.						
June 25	Cooymans, N. Y	27	Loss scarcely perceptible	60,000	Eagleville, Ohio	Grand River	Lake Erie	Chase and Mather.
June 26	do	28	do	60,000	Tremont, Ohio	Sandusky River	do	H. W. Welsher.
June 31	do	34	do	75,000	Logansport, Ind	Eel River	Wabash River	Mather and Vealey.
July 3	do	132	23,000	20,000	Hempstead, Tex	Brazos River		Milner, Mason, and Clark.
July 4	do	140	47,000	40,000	Austin, Tex	Colorado River		Do.
July 9	do	44	Loss imperceptible	70,000	Rockford, Ill	Rock River	Mississippi River	Welsher and Chase.
July 9	do	32½	do	75,000	Bellefontaine, Ohio	Miami River	Ohio River	Mather and Vealey.
July 15	South Hadley Falls, Mass	5	do	215,000	Bellows Falls, Vt	Connecticut River		Do.
July 27	do	5½	do	140,000	do	do		Chase and Brooks.
Aug. 1	do	5	do	120,000	do	do		Mather and Vealey.
Aug. 8	do	1	do	60,000	Smith's Ferry, Mass	do		H. J. Brooks.
Aug. 20	do	5½	do	30,000	Bellows Falls, Vt	do		Do.
July 18	do	24½	do	65,000	Monroeville, Ohio	Huron River	Lake Erie	H. W. Welsher.
July 18	do	23	do	65,000	Elyria, Ohio	Black River	do	Oren M. Chase.
July 22	do	36	do	80,000	Indianapolis, Ind	White River	Ohio River	Mason and Clark.
July 22	do	5	do	117,000	Putnam, Conn	Thames River		Mather and Vealey.
	do	8	do	23,000	Noank, Conn			Do.
July 25	do	15	do	100,000	Waterville, Me	Kennebec River		Mason and Clark.
July 28	do	23	do	100,000	Mattawamkeag, Me	Penobscot River		Welsher and Griswold.
Aug. 14	do	25	do	100,000	do	do		H. J. Brooks.
July 28	do	10	do	136,000	Vergennes, Vt	Otter Creek	Lake Champlain	Chase and Brooks.
	do	6	do	35,000	——, R. I	Blackstone River		Ellis.
July 30	do	33	do	80,000	Elkhart, Ind	Saint Joseph River	Lake Michigan	Frank N. Clark.
	do	51	do	61,000	Ottumwa, Iowa	Des Moines River	Mississippi River	Mather and Vealey.
	do	60	do	40,000	Des Moines, Iowa	do	do	Do.
July 31	do	33½	85,000	80,000	Columbus, Ind	Wabash River	Ohio River	H. J. Brooks.
Aug. 1	do	27	Loss imperceptible	80,000	Detroit, Mich	Detroit River	Lake Erie	Chase and Griswold.
Aug. 3	do	7½	do	100,000	New Milford, Conn	Housatonic River		Frank N. Clark.
Aug. 5	do	60	do	100,000	Saint Paul, Minn	Mississippi River		Chase and Vealey.
Aug. 6	do	31½	do	80,000	Corunna, Mich	Shiawassee River	Lake Huron	Frank N. Clark.
Aug. 10	do	2	do	80,000	Westfield, Mass	Westfield River	Connecticut River	Charles D. Griswold.
Aug. 13	do	24	do	200,000	do	do	do	Frederick A. Smith.
Aug. 11	do	11	do	120,000	Winooski, Vt	Winooski River	Lake Champlain	Brooks and Griswold.
Aug. 12	do	13½	do	80,000	Georgia, Vt	Lamoille River	do	Do.
	do	12	do	80,000	Swanton, Vt	Missisquoi River	do	Do.
Aug. 15	do	8½	do	50,000	Noank, Conn			Charles D. Griswold.
				3,031,000				

B—REPORT ON SHAD-HATCHING IN NEW JERSEY.

By G. A. Anderson.

I have the honor to submit the following report of shad-hatching operations on the Delaware for the year 1874, compiled from memoranda left by the late Dr. J. H. Slack, deputy commissioner.

In response to your telegram of June 23, Dr. Slack took the evening train to New York, and on the 24th called on you and received instructions. He left New York in the afternoon and reached Point Pleasant, Pa., (where the work was to be done,) on the 25th. His messenger from Troutdale met him with apparatus and the work was at once begun.

Owing to the very great drought prevailing at the time, the water in the river was very low, and the run of shad was small.

Dr. Slack remained at his post until the afternoon of July 2, when he returned to Troutdale, and on the following day was prostrated by a sudden attack of pleuro-pneumonia from which he never rallied, and which terminated fatally on the 27th of August. There is no doubt that exposure on the river at night, in the prosecution of his work, induced the disorder.

After Dr. Slack went away, the work was carried on by his assistant, William H. Swartz, who continued it until the 13th July, when he was ordered to cease operations. The number of spawn taken appears by the abstract hereto attached. It is proper to say that the water in the river was lower than had been known for many years, and that this interfered materially with the work. There appeared to be at all times a scarcity of male fish, and this fact prevented his increasing the number of spawn reported. It is probable that had Dr. Slack lived to continue the work this difficulty would have been overcome by keeping alive a few hours some of the males taken through the day.* An account of expenditures will be forwarded herewith. In conlusion, I will say that the importance of the work you have undertaken is beginning to be understood and appreciated by our people, and it is hoped you may be able to continue it.

All of which is respectfully submitted.

*Attempts to keep males confined for a few hours have usually resulted in their death.

Abstract showing spawn of shad taken by and under direction of the late Dr. J. H. Slack, deputy United States commissioner of fish and fisheries, on the Delaware River, at Point Pleasant, Pa., commencing June 25 and ending July 12, 1874.

	Time.	Air.	Water.	Spawn taken.
June 25, 1874	8 p. m.	77	74	35,000
June 26, 1874	10 p. m.	77	72½	75,000
June 27, 1874	8.30 p. m.			85,000
June 28, 1874	8.30 p. m.	83	72½	(Sunday.)
June 29, 1874	1.30 p. m.	97½	75	60,000
June 30, 1874	p. m.	83	76	No males taken.
July 1, 1874	9 a. m.	80	74	90,000
July 2, 1874*	5 p. m.	85	81	No spawn.
July 3, 1874	8 p. m.	72½	79	20,000
July 4, 1874	4 p. m.	84	79	20,000
July 5, 1874	7 p. m.	70½	74	65,000
July 6, 1874	5 p. m.	77	79	40,000
July 7, 1874	6 p. m.	73	78½	No spawn.
July 8, 1874	7 p. m.	80	80	No spawn.
July 9, 1874	6 p. m.	82	81	No males.
July 10, 1874	5 p. m.	83	80	No fishing.
July 11, 1874	5 p. m.	72	79	No spawn.
July 12, 1874†	5 p. m.	75	74	40,000
Total				530,000

* Record from July 2, kept by W. H. Swartz. † Ordered to stop by telegram from Dr. Slack.

Prof. SPENCER F. BAIRD,
United States Commissioner of Fish and Fisheries.
BLOOMSBURY, *October* 24, 1874.

C—VOYAGE TO BREMERHAVEN, GERMANY, WITH SHAD.

BY FRED MATHER.

On the morning of Tuesday, August 4, 1874, I left Holyoke, Mass., for New York to make preparations to receive the fish on board the steamer Donau, advertised to sail the next day. At midnight the fish arrived at the Grand Central depot, in charge of two men of the commission. There were ten cans, each containing 10,000 fry, hatched the morning before. The cans were ordinary milk-cans, capable of holding twelve gallons; two extra cans for water, and a double set of siphons, strainer-tubes, and dippers were also brought. An express-wagon conveyed them to the steamer's wharf at Hoboken, where they were taken on board the ship. On the morning of the 5th I was joined by Mr. A. Anderson, who was selected to assist in taking care of the fish on the passage. The cans were placed in a room 15 feet by 8. This room was a passage-way, between the gangways of the lower or cabin deck; it had also a stair leading to the upper deck; a door at each gangway and at the top of the stairs, which when closed made it a tight room. The steamer had two tanks filled with Croton water, expressly for our use; these were in the lower hold, and were of cast iron, lined with cement.

Mr. Anderson and myself divided our watches into six hours each,

and gave the fish fresh water every hour for the first six days, and every half-hour the four remaining ones that they lived. Our manner of giving it was this: about two gallons would be drawn from each can, and a dipper-full added each hour. In addition, on each watch the cans were drawn down half way, and the water aerated by pouring from one pail to another, and then replaced.

To keep the water in the cans sweet and wholesome, the dead were drawn off every morning; this was accomplished by swirling the water with a dipper, which caused all dead fish to collect in the center of the can; a siphon was then filled with water, and kept closed until it rested on this mass, when it was allowed to flow until all dead fish and sediment were removed.

The following is a table of temperatures and casualties:

Date.	Temperature in cans.				Remarks.	Loss.
	6 a. m.	Noon.	6 p. m.	Mid-night.		
	°	°	°	°		
Aug. 5	70	68	66	66	Gave water every hour	500
6	66	66	67	64		200
7	64	62	63	64	Emptied each can and cleaned it	1,000
8	64	62	64	64		20
9	62	62	64	64		100
10	64	65	67	73	Fog at night and hot	3,000
11	69	66	64	64	Gave water every half-hour as the fish were getting weak	500
12	62	64	64	63		1,200
13	63	62	62	62	Tried to feed them	5,000
14	64	59	60	61	All dead at noon but 1,000, which died at night	

The fish, in my opinion, died from starvation; hatched on the morning of the 4th, they were probably looking for food about the third or fourth day after, but appeared strong until the morning of the 12th, when we first noticed signs of weakness by a slow motion, and many alive resting on the bottom of the can.

On the morning of the 13th I procured a piece of raw beef, and washed it in water. I could see many particles in it, and it would have been good food for any of the salmonidæ, but the shad did not appear to notice it. I very much doubt, if the fish had been turned into a river full of their natural food at this time, that they would have lived, for they were past the point of reviving. It is doubtful if the Croton water that we had on board the ship contained the minute forms of animal life upon which the shad-fry feed. It was confined in tanks below three decks in the dark.

We now know the extreme limit of their endurance without food. They have been taken from the Hudson River to California in seven days, and have lived and will probably breed. Ours died of exhaustion in a trifle over ten days.

From this, and the reports in the "Forest and Stream," of the experiments by Comdr. L. A. Beardslee, at Noank, I do not regard the transportation of shad-fry as at all practicable on a journey occupying over

eight days, unless we can discover some method of feeding them. This seems at present difficult, and I have hope of a better result from taking the eggs and hatching the fry upon the passage. This seems to me to be the most practicable and easiest method; and in the connection I would refer to the hatching-can which I invented and have given to your commission. This was done too late for trial this season, and although intended for use on railroad-cars may be of service on shipboard.

The deputy commissioner, Mr. J. W. Milner, who had the charge of the shad-distribution, intended to have this can tried on our voyage, and when the fish were put up he had several thousand eggs put in the can; but on arriving at the railroad-station it was found that the wire cloth was of too large mesh; and that from the jolting of the wagon in which the can was brought to the depot the eggs had passed through to the bottom of the outer can.

If, by experiment, we find that we can hatch the eggs at sea, and, by the use of water at a temperature of 60° to 62°, delay the hatching until the fifth or sixth day out, then we may reasonably hope for success. The passage from New York to Bremerhaven occupied twelve days, and as two days should be allowed for distribution from that port, it will be a comparatively easy matter to get them through in eight days after hatching.

D—LIVING SHAD ON THEIR WAY TO THE WESER.*

TRANSLATED BY H. JACOBSON.

As has previously been mentioned, the German Fishing Society at Berlin was notified in June by Mr. Roosevelt, the commissioner of fisheries for the State of New York, that a number of live shad would be sent, which, however, never arrived in Germany, as, on account of the unusual heat, all the fish had died before they reached New York. Although we must acknowledge the earnest endeavors of Mr. Roosevelt, this first attempt must be conceded to have been a failure; and it is chiefly owing to the great interest which Prof. Spencer F. Baird, United States Commissioner of Fish and Fisheries, has taken in this matter, that another attempt has been made during this year. The circumstance that this year the migration-period of the shad in the Connecticut River, which generally lasts from April until the middle of July, was prolonged till near the end of July, made another attempt possible. With his peculiar energy Professor Baird knew how to make use of this circumstance, and in spite of the short time, made all the necessary arrangements in a manner which augured well for the success of the undertaking.

As early as the 7th August, Dr. Finsch received a cable telegram from Messrs. Oelrichs & Co., agents of the North German Lloyd in New York, announcing the shipping of a large quantity of live shad by

* From the "Weser-Zeitung," August 28, 1874.

the steamer Donau, Captain Neinaber, which left New York on the 5th August. The German Fishing Society thereupon intrusted Dr. Finsch, its corresponding member, with the care of placing the fish in the Weser, who was in this matter most willingly assisted by the practical advice of Mr. C. Schieber, the experienced fishing superintendent of the city of Hameln, who, fully appreciating the importance of the undertaking, personally placed himself at Dr. Finsch's disposal. Although no detailed information had been received from America regarding the number and age of the fish, or the manner of transporting them, all the necessary preparations were made for receiving the rare finny guests, the first which had ever crossed the ocean to be domiciled with us. All the details must of course depend on the condition of the fish at their arrival; and, in order to be informed of this in good time, Dr. Finsch asked Messrs. Keller, Wallis & Postlethwaite, agents of the Lloyd in Southampton, to telegraph immediately on the arrival of the fish regarding their condition. These gentlemen sent a telegram on the 15th, which arrived here on the 16th, saying that unfortunately the whole number of 100,000 fish had died on the day previous. A letter from Professor Baird, which Consul Schwab, in New York, had dispatched by the Prussian closed mail, announced the same day the arrival of Messrs. Frederic Mather and A. A. Anderson, in whose charge the fish had been placed. Dr. Finsch therefore went to Bremerhaven on the 17th August, and got from the above-mentioned gentlemen all the desired information and all the details, from which it is evident, beyond a doubt, that, in spite of the failure of this first attempt, the successful transportation of young shad is possible.

To understand the whole matter, we must speak of the particular difficulties attending the transportation of fish of the *Alosa* kind in a live state, which are much greater than with any representative of the *Salmonidæ*. Mr. Schieber was not able to keep our European *Alosa*, the *Alosa vulgaris*, alive more than twelve hours; and the American representative of this family, the shad, (*Alosa præstabilis*,) seems to be more tender, for, as Mr. Mather assured us, the attempt to put the mature shad in a vessel would prove fatal. The idea of transporting grown or half-grown shad can therefore not be entertained, just as little as that of spawn, as in this respect likewise the *Alosa* is subject to conditions of life differing entirely from those of the salmon. While in some varieties of these last-mentioned fish the eggs frequently require weeks for their development, which, moreover, can be retarded artificially by lowering the temperature—a circumstances of the utmost importance for transportation—this cannot be done with shad-eggs. These develop as early as the third or fourth day, and perish if the temperature is less than 72° to 80°, (Fahrenheit.) Another circumstance which facilitates the transportation of young salmon is this, that they keep the umbilical bag, which gives food to the young during the first period of their existence, from one to six weeks, while in the young shad this bag

is very small and is lost on the fourth day. In spite of all these peculiar difficulties, the transportation of young shad has been successfully carried on in America. Seth Green made a successful introduction of shad into California in 1871, and later Livingston Stone in 1873. The first grown shad was during this year caught in the Sacramento River, and the lucky fisherman received the State premium of $25 for it.

As the American pisciculturists are well acquainted with the difficulties attending the transportation of young shad, it was to be expected that Professor Baird would commission competent and experienced men to convey the first shad to Germany, and Messrs. Mather and Anderson have certainly done everything in their power to justify the confidence placed in them. It must here be mentioned that both these gentlemen are experienced pisciculturists, the former possessing a piscicultural establishment of his own for brook-trout, (*Salmo fontinalis*,) near Honeoye Falls, on the Honeoye Creek, a tributary of the Genesee River, fourteen miles south of Rochester, in the State of New York; while Mr. Anderson is successfully raising black bass (*Grystes nigricans*) and salmon-trout (*Salmo confinis*) at Groton, near New London, Conn. Both these gentlemen are several months during the year engaged by the United States Department of Fisheries to transplant young fish, and possess an experience of many years, especially regarding the transportation of shad.

Mr. William Clift, in July, 1872, succeeded in transporting a large number of shad to the Platte River, in Colorado, and, though of course losing quite a number, in planting the majority near Denver; and Mr. Mather, before undertaking the journey to Germany, had just returned from Des Moines, Iowa, where he had planted 90,000 shad for stocking the Mississippi. During the railroad journey of seventy-two hours, only 200 out of this large number had died. Both these gentlemen received their commission by letter from Professor Baird, and had just enough time to hasten to New York to receive the fish at the Grand Central depot and to take them over to Hoboken on board the Donau by express.

These fish came from the piscicultural establishment for raising shad which the State of Massachusetts established some years ago near Holyoke, on the Connecticut River, and which has been instrumental in re-stocking that river with shad in the most astonishing manner. This requires no expensive buildings, but only very simple appliances, which consist in 200 wooden boxes, 2 feet long and 1½ feet broad, open at the top and having a wire-net at the bottom, being placed in the river. These boxes receive the impregnated eggs and protect the young fish till they lose their umbilical bag. The shad-raising establishments of the State of New York, on the Hudson, ten miles below Albany, and that on the Potomac near Washington, are similarly organized. The young fish scarcely two to three hours old were shipped by railroad from Holyoke on the 4th August, at 2.30 p. m., and arrived in New York at midnight, *via* Hartford and New Haven Railroad, in a healthy condition, in

the same milk-cans in which they were to continue their journey across the ocean. These cans, which in America are very generally used for transporting milk on a large scale, are made of tin, round and about 2½ feet high, have been successfully employed in transporting fish. Such a can holds 10 gallons and affords ample room for 10,000 young fish, which will seem quite plausible if we inform the reader that the young shad on emerging from the eggs scarcely measure more than ⅛ of an inch in length. The whole number of fish, 100,000, could therefore easily be distributed in 12 cans, which, through the kindness of Captain Neinaber, had an excellent place on board the steamer where they were protected both against too violent movements and against the influence of the weather, as fresh air could constantly be admitted by means of a door, which could be closed when the temperature was too low. There was likewise a sufficient quantity of fresh water, which was brought by a small steamer from Croton River, and which filled two iron tanks, cemented on the inside, holding 1,500 gallons of water, destined for the exclusive use of the fish. The Croton water-works furnishes 60,000,000 gallons per day of water for the city of New York.

It must be said that both Messrs. Oelrichs & Co. and Captain Neinaber, with a zeal worthy of the cause, willingly did everything in their power to assist the fish-commissioners in their difficult task, and we express the sentiments of the American gentlemen, if we herewith publicly express their thanks to the above-mentioned representatives of the Lloyd.

As soon as the fish had been placed on board the Donau, which left Hoboken on the 5th August, Messrs. Mather and Anderson took them in charge. Their care for them consisted in the first place in filling in fresh water and introducing oxygen into the stale water. In transporting large fish this is done by means of bellows connected with the tank, and the so-called Freiburg transportation-kegs are built on this plan. Experience, however, has taught the Americans, who are well acquainted with this method, that it cannot be applied to young fish, and the only effectual remedy so far is the filling up of fresh water. This, of course, requires incessant activity by day and by night. Messrs. Mather and Anderson therefore relieved each other every six hours with a seaman-like regularity, which did not even suffer any interruption by slight attacks of sea-sickness. The business of filling up the water was attended to with the same regularity. By means of a tin cylinder and a rubber tube two gallons of water were carefully taken out every hour, and during the last part of the voyage even every half-hour. This water was supplied with new oxygen by pouring it continually from one vessel into another, the milky foam of the water indicating that the process had been finished. This water was then carefully filled in again by quarts, which for two gallons required several hours. Every three hours each can was up to one-third of its contents emptied by means of a siphon and filled with fresh water from the tanks. Dead fish had to be removed as

soon as possible, and the temperature had to be kept quite even. On the third day of the voyage the fish lost their sacs, which could be seen by the difference of their movements. While before this they had quietly moved round in a circle, they now made rapid jerking movements from one side of the can to the other, as if they were in search of food. Two days after losing their sacs, 9th August, the fish were thriving; but from this time they gradually fell off, their bodies became thinner, more thread-like and transparent, whereby the large head seemingly increased in size. On the 13th August the young fish were very much exhausted, their movements grew slow, and the gentlemen prepared themselves for a total loss, which took place during the night from the 13th to the 14th August, in the English Channel, a short time before the arrival of the vessel in Southampton, after the little fish had been kept alive two hundred and fifty hours in all. According to Mr. Mather's diary the daily list of losses was as follows: 5th August, no losses; 6th August, 200 lost; 7th, 1,000; 8th, 20; 9th, 100; 10th, 3,000; 11th, 500; 12th, 1,200; 13th, 5,000; the 14th, all the remainder, almost 90,000. It need not be said how painful it was for the two American gentlemen, when they had to throw overboard the object of their incessant care during ten days; for this deprived them of the great triumph of having been the first to transport live fish across the ocean, the prize for which they had gone to so much trouble. But in spite of their failure these gentlemen may feel proud of the result of their undertaking, for while young shad had hitherto only been transported alive one hundred and eighty-four and a half hours, they succeeded in keeping them alive two hundred and fifty hours. The practical experience gained is likewise of great importance, and every pisciculturist will agree with us in assuming that the possibility of success can no longer be considered doubtful. Messrs. Mather and Anderson shared this view, and we rejoice to hear that so experienced a pisciculturist as Mr. Schieber, of Hameln, entirely agrees with them. Mather and Anderson felt convinced that nothing but want of food was the cause of the total loss; but unfortunately they had to see the fish die without being able to save them, as so far but very little is known regarding the food of young shad. Very small, almost microscopic animals will certainly form their food during the first days, but it proved impossible to supply their place by meat; and blood, which has in similar cases been successfully employed, was of no use. It is well known that the grown shad lives on various crustaceans, and that, like the salmon, it takes no food during the period of its migration in fresh water, but as regards the food of the young shad, we are so far entirely in the dark. Messrs. Mather and Anderson are going to make extensive experiments during next year, and will doubtless be in every possible way assisted by Professor Baird in his influential position as United States Commissioner of Fish and Fisheries, as the introduction of the shad into Europe is one of the pet plans of this eminent naturalist. To his energy and influence we owe in the first place this attempt, the ex-

penses of which, as far as the fish and their attendants are concerned, were borne by the United States Fishery Commission, while the directors of the North-German Lloyd afforded a free passage, in order to give also some German support to an undertaking which promises to prove of incalculable benefit to our country.*

Convinced that the interest in this important matter will not decrease in America, we hope to be able to meet the two experienced pisciculturists, Mather and Anderson, again next year on the Weser, and wish them a final success in their endeavor to transport live young shad across the ocean.

E—SHAD HATCHING AND DISTRIBUTING OPERATIONS OF 1875.

1.—THE NEUSE RIVER STATION.

The shad work of 1875 began on the Neuse River of North Carolina about the 1st day of April. A few days were spent in a reconnaissance of the river, in order to find the best point for a hatching-station, and the fishing was delayed a number of days by the very high stage of water. Between the 9th and the 12th, the river rose 26 inches; after this date it began to fall. On the 13th of April, a camp was established a few miles below Kinston. Seine hauling began on the 14th. The water continued to fall until the 23d, falling in all 5 feet and 1¼ inches, an average of 5.5 inches a day; but owing to the continual rains in the region of the upper waters, the fall was very irregular, and varied from ¾ of an inch to as much as 13½ inches in one day.

On the 23d, the gauge showed a rise at 6 p. m. of ½ inch, and the water continued to rise from 2½ to 7½ inches a day until the 27th, when it had gone up 23 inches. The morning of the 28th it had fallen 1½ inches, and continued to fall, in all 30½ inches, until the end of the month. The fall on the 29th was 15 inches. May 1 it again began to rise, and on May 5 had risen 23 inches, when it began to fall, and on the 7th had again fallen 12 inches. The camp was broken up on the 10th, and no records kept after the 7th. The extent of oscillation in the twenty-nine days of observation was about 5.7 feet. The variations of temperature were in the air between 32° and 80°; in the water 53° and 65°.

The fisheries were watched continually, and the examination of over 600 shad failed to find any ripe ones, with the exception of 14 males, soon after the camp was established. No eggs were obtained. Short excursions to different fisheries a few miles farther down the river were attended with no better success. The camp moved from this point to the Potomac.

* This effort on Professor Baird's part was mainly prompted by his desire to make a suitable return for the liberality of the German government in presenting the United States Fish Commission with 250,000 impregnated eggs of the salmon of the Rhine.

2.—THE PAMUNKEY RIVER STATION.

In the mean time, a reconnaissance was made of the James, York, and Pamunkey Rivers, Virginia, and a point on the latter near the historic White House, was selected for the hatching-station. Mr. Fred Mather was appointed to take charge of this, and arrived on the 11th of May, and continued until the 20th, taking a few shad-spawn, which did not seem to be healthy, and from which no fish resulted.

3.—THE POTOMAC RIVER STATIONS.

The work on the Potomac began on the 14th of May. Previous to this time, a general reconnaissance of the fisheries had been made on the steamer Triana, and points determined upon for the hatching-stations.*

The first station, placed in charge of Mr. Jonathan Mason, was established at Free Stone Point, Va., the property of Mr. J. W. Fairfax. Mr. J. D. Faunce had the fishery, and was quite willing and obliging in all our relations with him, affording the fishes from each haul, and furnishing assistance when it was needed. Ripe fish were obtained from the time we arrived here until the fishing stopped.

The temperature of the river, owing to the cold season, was quite low and at first the development of the eggs was very slow. On the 15th, the temperature did not rise above 64°, and this was the highest water temperature until the 20th, when a gradual rise began. The young fish also seemed to suffer a degree of torpidity in the cold waters. The first fish were turned loose on the 21st, five days after the eggs were impregnated. The seine in use at this station was a large one, and the large expenses attending the fishing with the poor returns did not permit its continuance later than the 21st.

There were hatched altogether at this station and turned into the river 1,156,750 shad. Mr. Mason's camp was removed to Moxley Point, Md., at J. D. Skidmore's fishery on the 25th.

In the mean time, on the 18th of May, a station was established at the end of Long Bridge, opposite Washington, D. C., and put into the hands of Mr. H. W. Welsher. This was continued until June 5, and 1,072,800 shad were turned into the river at this point.

While this station was in progress, Mr. Welsher also carried on operations at Ferry Landing, Va., near Mount Vernon. This station produced the largest results of any one established on the river, as it was begun on May 21 and closed on May 29, and in only nine days 1,473,500 young shad were turned into the waters.

The Moxley Point (Md.) station continued from May 26 to June 7, and 1,182,500 shad were turned into the water.

The entire number hatched and put into the Potomac River was 4,885,550.†

The spawning-season in the river continues longer than the large seines find it profitable to fish. The height of the spawning-season begins about the 22d of May and lasts during the first week of June.

* See report on the Triana trip on subsequent page. † See tables on subsequent page.

The earliest spawners may be taken during the latter half of April. At this time, ripe males are abundant and become rather scarce late in the season. The large seines "cut out" at the fisheries about the 14th of June, and the fishing is continued by the small seines, pound-nets, and drift-nets until late in the summer.

4.—THE DISTRIBUTION OF SHAD FROM THE HUDSON RIVER.

The different camps were broken up entirely about June 7, and by the 10th the men were all off to the Hudson. From this point, the first shipment was made on the 11th of June, Messrs. Frank N. Clark and H. E. Quinn starting on the 11th for the White River of Indiana with 100,000 shad.

Shipments were made from here to the White, the Muskingum, the Scioto, the Des Moines, and to the Colorado of Texas; in all about four hundred and twenty-five thousand shad were distributed from this point.*

5.—THE CONNECTICUT RIVER STATION.

On the 1st of July, the parties moved to Holyoke, and shipments were begun to the South and West. The fishery below Holyoke was visited, and a couple of seine-hauls made for the purpose of judging of its advantages as a hatching-station. A small catch was obtained, and the fact of the availability of another hatching-location pretty well established, if it ever should be found necessary to use a second one.

Commissioner Brackett, of Massachusetts, and Commissioner Hudson, of Connecticut, came to Holyoke, and with them the general plan of the work was discussed.

It was decided that one-half of all fishes hatched should be returned to the Connecticut; and the proposal on the part of the United States was made to place one-fourth of the fish above the dam, in order that a colony might become established there which would be likely to have the desire for returning to this portion of the river when they had become mature fishes. A few shad of 8 to 12 inches in length, taken in the fishway, were thought to be from the stock placed above the dam at Bellows Falls, Vt., during the two previous years.

There were distributed in waters of New England, other than the Connecticut, 320,000 shad; distributed in waters of the United States in the Mississippi Valley and tributary to the Gulf of Mexico, 590,000; carried to the Upper Connecticut, 1,205,000; hatched and put in below the dam, 4,500,000; sent to Germany, 400,000—about 7,000,000 in all.

Two hundred thousand were sent from the Delaware, one-half to the Stanton River, headwaters of the Roanoke, and one-half to the Pearl River of Mississippi and Louisiana. The total of fish hatched and turned into the waters of the rivers which afforded the ripe fish and eggs and those sent away to distant waters was 12,500,000.

*See Tables.

6.—EXPERIMENTS WITH A VIEW TO TRANSPORTING SHAD TO GERMANY.

The failure of the German expedition the previous year induced a careful series of experiments with reference to the conditions most favorable to sustaining shad-eggs or embryo-fish for a prolonged period in transportation-vessels. The experiments made at Noank, Conn., the previous summer, proved that there would be no hope in attempting to inure the shad to sea-water so as to depend on fresh supplies of water from the ocean after the steamer was under way.

The first experiment begun this year was at Washington, D. C. Mr. Fred Mather, who was one of the attendants on the shipment of shad in the first German trip, was given charge of the work. He devised a can holding about eight gallons, and having the form of a cylinder for about two-thirds of its upper portion; below this, the remaining third had the form of a funnel. This was hung in gimbals, as it was intended it should be on shipboard. The water-supply entered at the bottom coming from a reservoir at a higher level, and flowed upward through a screen of wire-cloth, which rested upon the line at the bottom of the cylinder and top of the funnel. Upon this were placed about 20,000 shad-eggs.

For a day or two, they seemed to survive well, but soon an increasing mortality was evident, and after four days the last one was dead. Mr. Mather left Washington on June 11, and went to Point Pleasant, Pa., on the Delaware River, and began an experiment with a similar though smaller apparatus, and with little success.

An apparatus differing in being entirely of a funnel form and having only the inlet-tube covered with wire-cloth,* was the suggestion of Mr. Mather's assistant, Mr. Charles Bell.† This worked admirably, and young shad were produced seemingly with all the success and facility of the floating shad-boxes.

In the meanwhile an experiment was begun by Mr. H. W. Welsher, at the New York shad-hatching station on the Hudson River. His attempt was to retard the development of the eggs in a case of flannel-screens, upon which they were placed. The screens, fitted with light covers of the same material, slid into the case like drawers, one above the other, in a series of ten or twelve. One of the sides of the case was fitted on hinges as a door. Lumps of ice were placed in the upper screen, the drippings from which supplied the necessary moisture to the eggs. The temperature was moderated by means of the door. The development of the eggs was retarded by a low temperature, so as to hatch after six days and even ten, and seemed, when put into the water, just before the release of the fish, to be in a healthy condition, and the fish when hatched seemed vigorous.

Mr. Monroe A. Green was associated with Mr. Welsher just before it was decided to make the attempt of a trip to Germany; the announcement of their readiness to attempt the work arriving in advance of that from Mr. Mather, who was at the time experimenting on the Delaware.

* See Apparatus for hatching shad-ova while enroute to new waters. † Since deceased.

Mr. Green now arranged a can made in similar form to that which Mr. Bell had devised, but instead of agitating the water and eggs by an inflow of water he applied a current of air from an air force-pump, the bubbles and force of the air rising from the bottom of the can carrying upward a current of water and the eggs, which slowly fell back toward the bottom, to again be carried upward by the in-rushing air.

The purpose of the can was to receive the eggs when they had undergone their slow development in the screens to the point when they were nearly ready to break the shell and release the young shad into the water.

Mr. Welsher and Mr. Green were quite confident of the efficiency of their apparatus, and expected to make a success of the trip.

7.—THE TRIP TO GERMANY.

On the nights of the 15th and 16th July, Mr. Green took a large quantity of shad-eggs at the station at South Hadley Falls, Mass., on the Connecticut River. Those chosen for the voyage were very carefully selected, all light eggs floating to the surface were allowed to float out of the pan, and the manipulation in the impregnation of the eggs was very carefully managed, and the ripe fish critically examined before eggs or milt were taken.

About 400,000 impregnated eggs were placed in the cases; large boxes were obtained in which the cases of eggs were packed. The method of packing was to lay a bottom thickness of four or five inches of turners' shavings, upon which the case rested. The same thickness was tamped in around the side, and over the top was put a heavy layer of the shavings and lumps of ice.

The boxes were put into the baggage-car on the morning of the 17th and arrived at New York on same day. They were moved to the steamer Donau in a light-spring wagon, and put on board about 1 p. m.

The place afforded by the officers of the steamer was the middle hatchway, which had been fitted up between decks into a commodious room. Timber-posts had been put in strengthening the hatch-cover overhead, and nine of the cans arranged by Mr. Green, each of about ten gallons' capacity, were suspended by chains. A rubber hose led from each of these to an air-chamber, into which the air was forced by an air force-pump, and through the hose distributed to each of the cans.

The cases of eggs were placed on the floor and the ice kept near by in a small ice-chest.

The steamer left on the 17th. After getting under way, Mr. Welsher and Mr. Green opened the cases of eggs, and, to their dismay, perceived that they had been injured during the transportation from the Connecticut River to the steamer.

No development seemed to take place at all in the eggs, and no fish were hatched. The jolting of the baggage-car between Holyoke, Mass., and New York had evidently entirely destroyed the vitality of the eggs.

The following tables exhibit the physical observations, the number of fish taken, and the number of fish put into the river at the different stations.

Record of shad-hatching operations conducted at Camp Milner, near Kinston, N. C., on the Neuse River, from April 12, 1875, to May 8, 1875, on account of United States Commission of Fish and Fisheries, by Welsher, Mason, and Quinn.*

Date.	Hour.	Temperature of—		Wind.		Condition of—		Rise and fall of river.	Seine hauled.	Fish taken.		Ripe fish.		Eggs obtained.	Remarks.
		Air.	Surface water.	Direction.	Intensity.	Sky.	Water.			Males.	Females.	Males.	Females.		
		°	°												
Apr. 14	6 a. m.	45	59	W. by S.	Fresh	Clear	Clearing	4½ inches fall.	30 times from 8.30 a. m. to 6 p. m.	6	4	6	....	None	Mr. Tilghman's seine in use.
14	12 m.	60	59	N.	do	Light clouds	do	1½ inches fall							
14	6 p. m.	58½	59½	S.	Calm	do	do	3½ inches fall							
15	6 a. m.	44½	57½	S. E.	do	do	do	3 inches fall							
15	12 m.	63	59½	N. W.	Fresh	Few clouds	do	1½ inches fall	6.30 a. m. to 6.00 p. m.	8	5	8	.....	do	A few drops of rain at 11.30 a. m.
15	6 p. m.	58½	60	S. by W.	Calm	Clear	do	1 inch fall							
16	6 a. m.	54½	59	S. by W.	do	Light clouds	do	1½ inches fall							
16	12 m.	71	59	S.	Fresh	Few clouds	Roily	1½ inches fall	7.00 a. m. to 6.30 p. m.	4	10	.....	.....	do	
16	6 p. m.	59	58½	S. W.	Gale	Clear	do	Standstill							
17	6 a. m.	35	58	N. by E.	Light	do	do	1 inch fall							
17	12 m.	62	57	N. W.	Fresh	do	do	1½ inches fall	7.00 a. m. to 4.00 p. m.	7	5	.....	.....	do	Seine hauled 3 times at night.
17	6 p. m.	44	56	N. W.	do	do	do	½ inch fall		6	5				
18	6 a. m.	32	55	S. W.	Light	do	Clearing	do							
18	12 m.	36	54	W.	Fresh	Cloudy	do	½ inch fall	10.00 a. m. to 12.30 p. m.	2	2	.....	.....	do	Ground covered with snow.
18	6 p. m.	35	55	W.	do	do	do	Standstill							
19	6 a. m.	32	53	S. E.	Light	Clear	do	½ inch fall							
19	12 m.	46	54	W.	Fresh	do	do	2 inch fall	9.00 a. m. to 7.30 p. m.	12	17	.....	.....	do	Sprinkle of rain at 8.30 a. m. The second seine, Mr. Simmons', commences fishing.
19	6 p. m.	50	55	S. E.	Light	do	do	1½ inches fall							
20	6 a. m.	52	54	S. W.	do	Cloudy	do	4 inches fall							
20	12 m.	68	55	W.	Fresh	do	do	3½ inches fall	7.00 a. m. to 6.30 p. m.	34	17	.....	.....	do	
20	6 p. m.	66	56	N. E.	Light	do	do	do							
21	6 a. m.	44	54	N. E.	Fresh	Raining	Roily	7 inches fall	7.00 a. m. to 6.30 p. m.	8	4	.....	.....	do	Hauled in the night.
21	12 m.	38	54	N. E.	do	do	do	3½ inches fall		37	16				
21	6 p. m.	41½	54	.....	Calm	Cloudy	do	3 inches fall							
22	6 a. m.	35	53	N. E.	Gentle	do	do	6 inches fall							
22	12 m.	53½	54	N.	do	Clear	do	2 inches fall	6.00 a. m. to 7.00 p. m.	27	31	.....	.....	do	2 seines hauled.
22	6 p. m.	50	54	.....	Calm	do	do	1½ inches fall							
23	6 a. m.	41½	53	E.	Gentle	Cloudy	do	3½ inches fall							
23	12 m.	50	53	E.	Fresh	do	do	1 inch fall	7.00 a. m. to 6.00 p. m.	14	6	.....	.....	do	
23	6 p. m.	50	53	N. E.	Gentle	do	do	½ inch rise							
24	6 a. m.	41	53	.....	Calm	Clear	Muddy	1 inch rise							
24	12 m.	63	54	W.	Fresh	do	do	3 inches rise	7.00 a. m. to 7.00 p. m.	15	10	.....	.....	do	Hauled at night.
24	6 p. m.	53	54	W.	Gale	Cloudy	do	2 inches rise							
25	6 a. m.	41½	53	N. W.	Strong	Clear	do	4 inches rise							
25	12 m.	51	53	N. W.	Gentle	do	Roily	2 inches rise.	.....	.....	.....	.....	.....	do	Sunday; did not fish.
25	6 p. m.	48	53	.....	Calm	Cloudy	do	1½ inches rise							

	26	6 a. m..	39½	54	.....	...do	Clear	...do	¾ inches rise							
	26	12 m	64½	55½	S. W.	Gentle...	...do	...do	2 inches rise.	7.30 a. m. to 6.30 p. m.	20	15	.....	.....	.....	
	26	6 p. m..	60	55½	N.	Fresh...	Cloudy.....	...do	1 inch rise...							
	27	6 a. m..	60	57	N. E.	Gentle...	... do	...do	2 inches rise							
	27	12 m	68	58	E.	Fresh...	Rained	...do	½ inch rise...	6.00 a. m. to 6.30 p. m.	5	13	.....	.....	.....	
	27	6 p. m..	66	59	S. E.	.. do	Cloudy.....	...do	Standstill ...							
	28	6 a. m..	67	59	.....	Calm	...do	...do	1½ inches fall							
	28	12 m	55½	58	N. W.	Fresh....	...do	...do	2 inches fall	6 00 a. m. to 6.00 p. m.	4	7	.....	.....	.....	Thunder-storm 10 a. m
	28	6 p. m..	55	58	N.	...do	Clear	...do	3 inches fall							
	29	6 a. m..	45	58	.....	Calm	...do	... do	7 inches fall							
	29	12 m	69	59	S. E.	Light....	...do	...do	4 inches fall	4.30 a. m. to 5.00 p. m.	2	2	.....	.....	.....	2 seines hauled.
	29	6 p. m..	64	59	S.	Strong....	...do	...do ...	....do							
	30	6 a. m..	58	60	S.	Calm	...do	...do ...	6 inches fall							
	30	12 m	80	61½	W.	Strong...	...do	...do	2 inches fall	7.00 a. m. to 5.00 p. m	9	11	.....	.....	.....	
	30	6 p. m..	77	63	S. W.	Gentle...	...do	...do	1 inch fall...							
May	1	6 a. m..	65	63	S.	...do	Hazy	...do	1 inch rise ..							
	1	12 m	74	63	S.	Strong...	...do	...do	1½ inches rise	6.00 a. m. to 12 m	3	3	.....	.....	.....	
	1	6 p. m..	70	64	S.	...do	Cloudy	...do ...	2 inches rise							
	2	6 a. m..	64	64	S. W.	Gentle...	Clear	Muddy.	3 inches rise							
	2	12 m	68	64	N. W.	...do	...do	...do	2 inches rise	.....	.....	.....	.....	.....	.....	Severe thunder-storm in the night.
	2	6 p. m..	63	65	N. W.	Calm	...do	...do	3 inches rise							
	3	6 a. m..	48	65	.....	...do	... do	...do	3½ inches rise							
	3	12 m	62	65	S. E.	Gentle...	...do	...do	1½ inches rise	9.00 a. m. to 7.00 p. m	11	7	.....	.....	.....	
	3	6 p. m..	61	65	S. E.	Strong...	Hazy	...do	1 inch rise ..							
	4	6 a. m..	61	65	S.	Gentle...	Raining.....	...do	2¼ inches rise							
	4	12 m	66	65	N. W.	Fresh...	Hazy	...do	1 inch rise ..	7.00 a. m. to 6.00 p. m	13	10	.....	.....	.....	51 shad examined at More's fishery; none ripe.
	4	6 p. m..	60	65	W.	Gentle...	Cloudy	...do	....do							
	5	6 a. m..	44	64	N. E.	.. do	Clear	...do	Standstill ...							
	5	12 m	70	65	S. E.	...do	...do	Rolly ...	¼ inch fall...	.....do	3	4	.....	.....	.....	
	5	6 p. m..	52½	65	S.	Fresh...	Cloudy	...do	....do							
	6	6 a. m..	51	65	S.	Gentle...	...do	...do	2¼ inches fall							
	6	12 m	74½	65	S. W.	...do	... do	...do	1½ inch fall..	6.00 a. m. to 5.00 p. m	4	4	.....	.....	.....	
	6	6 p. m..	66	65	.....	Calm	Clear	...do	2 inches fall							
	7	6 a. m..	53	65	W.	Gentle...	...do	Clearing	3 inches fall							
	7	12 m	70	65	W.	...do	...do	...do	1½ inch fall..	6.00 a. m. to 6.00 p. m	3	6	.....	.....	.....	
	7	6 p. m..	61	65	N. E.	...do	...do	...do	1 inch fall....							
Totals											257	214	14	.....	.....	Number of shad examined, 522.

*No ripe fish obtained at this station.

Record of shad-hatching operations conducted at West Island, near Fish Haul, Va., on the Pamunkey River, from May 11, 1875, to May 20, 1875, on account of United States Commission of Fish and Fisheries, by Fred Mather.

Date.	Hour.	Temperature of—		Wind.		Condition of—		Fish taken.*		Ripe fish.		Eggs obtained.	Loss, number.	Remarks.
		Air.	Surface-water.	Direction.	Intensity.	Sky.	Water.	Males.	Females.	Males.	Females.			
		°	°											
May 11	5.00 p. m	62	68				Roily	93	9	20				Seine 800 yards long.
12	6.30 a. m	60	68					10	11			10,000	8,000	
13†	7.00 a. m							20	24					
13	7.30 p. m							24	18					
14	8.00 a. m							10	11					
15	9.30 a. m	62	65	S. W.	Fresh	Cloudy		1						
15	12 m	76	69	W.	Strong									Did not fish. The waves washed over box of eggs taken on the 12th. Fishermen left until Tuesday night. They say the season is over. Took 90,000 eggs from gill-nets; all bad.
15	7.00 p. m	74	70	N. W.	Violent									
16‡														
18	11.00 p. m			N.	Light	Clear		4	7					
19	12.30 a. m				Calm	do		3	1					
19	2.00 p. m			W.	Light	Light clouds		2	4					
20§	3.00 p. m			W.	do	do		5	1					
Totals								102	86	20		10,000	8,000	

* Seine hauled once at each flood-tide.
† Thermometer broken.
‡ Thermometer lost overboard.
§ The fishing with seine stopped. The gill-nets still take a very few fish.

Record of shad-hatching operations conducted at Free Stone Point, Va., on the Potomac River, from May 15, 1875, to May 25, 1875, on account of United States Commission of Fish and Fisheries, by Jonathan Mason.

Date.	Hour.	Temperature of— Air.	Temperature of— Surface-water.	Wind. Direction.	Wind. Intensity.	Condition of— Sky.	Condition of— Water.	Tide. High-water.	Tide. Low-water.	Seine hauled.	Fish taken, males and females.	Ripe fish, females.	Eggs obtained.	Period of hatching.	Young shad turned loose.	Remarks.
		°	°													
May 15	6 a. m..	58	56	N. E.	Gentle	Clear...	Roily .	4.00 a. m..	.....	11.00 a. m..	170	4	.....	.....	.....	Eggs all dead.
15	12 m ...	80	60	N.	..do ...	..do ...	..do ...	.....	11.30 a. m..	5.00 p. m .	175	4	125, 000	4 days ..	.....	
15	6 p. m..	63	64	W.	Strong	Cloudy	..do ...	4.00 p. m...	11.10 p. m.	11.30 p. m..	100	2	50, 000	3 d. 18 h..	.....	Thunder-storm 3 p. m.
16	6 a. m..	50	53	N.	..do ..	Clear...	..do ...	5.30 a. m...	.....	No haul...	.....	.....	.....	.....	.....	Seine "mudded".
16	12 m ...	60	59	N.	Gentle	..do	..do ...	.....	12.15 p. m ..	...do	.....	.....	.....	.....	.....	
16	6 p. m..	58	61	N.	..do ...	..do	..do ..	6.00 p. m...	.....	11.30 p. m..	170	3	75, 000	3 d. 22 h..	.....	
17	6 a. m..	52	56	N. W.	..do ...	..do	..do ...	6.30 a. m...	.....	No haul...	.....	.....	.....	.....	.....	
17	12 m ...	60	61	N. W.	..do ...	..do	..do ...	.....	12.30 p. m..	1.30 p. m..	140	4	110, 000	3 d. 15 h..	.....	
17	6 p. m..	57	61	N. N. W.	..do ...	..do	..do ...	6.15 p. m...	.....	7.00 p. m .	237	12	298, 000	3 d. 15 h..	.....	
18	6 a. m..	52	58	S. S. W.	Fresh	..do ...	..do ...	6.25 a. m...	12.05 a. m..	1.00 a. m..	40	2	52, 000	3 d. 12 h..	.....	
18	12 m ...	63	62	S. W.	..do ..	Cloudy	..do ...	.....	12.15 p. m ..	1.00 p. m..	87	.....	.....	.....	.....	
18	6 p. m..	55	61	S.	Calm	Hazy ...	..do ...	6.50 p. m..	.....	7.00 p. m.	184	10	205, 000	3 d. 12 h..	.....	
19	6 a. m..	45	58	S.	..do ...	Clear...	..do ...	6.15 a. m...	12.50 a. m..	No haul..	.....	.....	.....	.....	.....	
19	12 m	72	64	S. W.	Gentle	..do	..do ...	.....	12.00 m	1.15 p. m..	186	4	85, 000	3 d. 6 h...	.....	
19	6 p m..	68	64	S. W.	..do ..	Hazy ...	..do ...	6.10 p. m...	.....	7.30 p. m .	149	8	205, 0 0	3 d. 6 h...	.....	
20	6 a. m..	52	59	S.	Strong	..do	..do ..	6.10 a. m...	12.15 a. m..	1.00 a. m..	45	.....	.....	.....	.....	Blowing hard.
20	12 m	80	65	S.	..do	..do	..do ...	.....	11.50 a. m..	2.00 p. m.	126	.....	.....	.....	.....	Seine "mudded" and fish all dead.
20	6 p. m..	81	68	S.	..do ...	..do	..do ...	6.10 p. m.	.....	8.30 p. m..	130	1	25, 000	3 days ..	.....	
21	6 a. m..	56	62	S. W.	Light	..do	..do ..	6.10 a. m...	12.15 a. m..	2.00 a. m..	32	.....	.....	.....	103, 500	
21	12 m ...	73	72	S. E.	..do	..do	..do ...	.....	12.15 p. m .	2.30 p. m..	40	.....	.....	.....	.....	4 ripe fish; eggs all dead.
21	6 p. m..	63	76	S. E.	..do	..do	..do ...	6.21 p. m...	.....	9.00 p. m..	101	6	125, 000	.....	.....	
22	6 a. m..	62	68	S. W.	..do	..do	..do ..	6.20 a. m...	12.25 a. m..	2.30 a. m..	20	.....	.....	.....	45, 000	Seine "cut out".
22	12 m	78	72	S.	Gentle	..do	Clear..	.....	12.00 m...	.....	.....	.....	.....	.....	70, 000	Thunder-shower 3 p. m.
22	6 p. m..	68	75	S. W.	..do ..	..do	..do ...	6.00 p. m...	.....	.....	.....	.....	.....	.....	100, 000	
23	6 a. m..	63	69	S. E.	..do ..	..do	..do ...	6.10 a. m...	12.15 a. m..	.....	.....	.....	.....	.....	230, 000	Seine "cut out".
23	12 m	84	79	S. E.	Light	..do	..do ...	.....	11.50 a. m..	.....	.....	.....	.....	.....	47, 000	
23	6 p. m..	82	78	S. E.	Strong	..do	..do ...	6.00 p. m...	.....	.....	.....	.....	.....	.....	175, 000	
24	6 a. m..	70	72	S. E.	Gentle	Cloudy	..do ...	6.30 a. m...	12.10 a. m..	.....	.....	.....	.....	.....	75, 000	
24	12 m	80	73	S. E.	Light	..do	..do ...	.....	12.00	.....	.....	.....	.....	.....	170, 000	Shower at 2.30.
24	6 p. m..	69	75	E.	..do ...	.....	..do ...	6.10 p. m...	.....	.....	.....	.....	.....	.....	21, 250	
25	6 a. m..	66	71	E.	..do ...	Rainy ...	..do ...	6.00 a. m...	12.10 a. m..	.....	.....	.....	.....	.....	100, 000	Rained all night.
25	12 m	81	75	S. E.	..do ...	Cloudy	..do ...	.....	12.00 m....	.....	.....	.....	.....	.....	.....	
Totals.....											2, 929	60	1, 355, 000	.....	1, 156, 750	

Record of shad-hatching operations conducted at Jackson City, Va., on the Potomac River, from May 18, 1875, to June 5, 1875, on account of United States Commission of Fisheries, by H. W. Welsher.

Date.	Hour.	Temperature of—		Wind.		Condition of—		Tide.		Seine hauled.	Fish taken.		Ripe fish.		Eggs obtained.	Period of hatching.	Young shad turned loose.
		Air.	Surface of water.	Direction.	Intensity.	Sky.	Water.	High-water.	Low-water.		Males.	Females.	Males.	Females.			
		°	°														
May 18	6 a. m.	.....	60	W.	Gentle..	Clear ...	Roily ...	6.24 a. m	.....	6 times on each ebb-tide.	6	20	.....	.....	.....	.....	.....
18	12 m....	.....	61	W.	...do	...do ...	...do	.....	1.13 p. m	...do							
18	6 p. m..	.....	61	W.	...do	...do ...	...do	6.41 p. m.	.....	...do							
19	6 a. m..	.....	61	W.	...do ...	Clouds...	...do	7.03 a. m	1.33 a. m.	...do							
19	12 m....	.....	62	W.	Gale ..	Rain ...	...do	.....	1.51 p. m	...do	16	42	.....	.....	.....	.....	.....
19	6 p. m..	.....	62	W.	Gentle..	Clear ...	...do	7.23 p. m	.....	...do							
20	6 a. m..	.....	63	N. W.	Strong...	...do	...do	7.41 a. m.	2.11 a. m	...do							
20	12 m....	.....	64	N. W.	Gentle...	...do	...do	.....	2.30 p. m	...do	10	30	2	1	12,000	3½ days ...	.....
20	6 p. m..	.....	64	N. W.	Strong...	Hazy	...do	8.01 p. m	.....	...do							
21	6 a. m..	67	64	N. W.	Calm ...	...do	Clear ...	8.21 a. m	2.50 a. m	...do							
21	12 m....	73	69	S. E.	Gentle...	...do	...do	.....	3.10 p. m	...do	11	23	1	1	15,000	3½ days ...	.....
21	6 p. m..	76	71	S.	...do	...do	...do	8.40 p. m	.....	...do							
22	6 a. m..	72	66	.....	Calm	...do	...do	9.00 a. m.	3.30 a. m.	...do							
22	12 m....	76	73	S. E.	Gentle...	...do	Roily ...	.....	.....	...do	8	3	1	3	60,000	3 days	.....
22	6 p. m..	72	70	W.	...do	...do	...do	9.21 p. m	4.00 p. m.	...do							
23	6 a. m..	76	71	.....	Calm	...do	Clear ...	9.43 a. m.	4.10 a. m.	...do							
23	12 m....	78	75	.....	...do	Clear ...	...do	.....	.....	...do	10	20	1	1	15,000	3 days	.....
23	6 p. m..	70	70	.....	...do	...do	...do	10.06 p. m	4.32 p. m.	...do							
24	6 a. m..	67	70	S.	Gentle..	Hazy	...do	.....	4.55 a. m.	...do							
24	12 m....	77	74	S. E.	...do	...do	...do	10.20 a. m	.....	...do	7	18	2	4	70,000	.....	.....
24	6 p. m..	73	73	S. E.	...do	Rain ...	Roily ...	10.52 p. m	5.20 p. m.	...do							
25	6 a. m..	71	74	E. N. E.	...do	...do	...do	.....	5.41 a. m.	...do							
25	12 m....	74	74	.....	Calm ..	Hazy	...do	11.14 a. m	.....	...do	7	21	1	2	40,000	3 days	.....
25	6 p. m..	73	73	E.	Gentle...	...do	Clear ...	11.39 p. m	6.13 p. m	...do							
26	6 a. m..	72	72	N.	...do	...do	Roily ...	.....	6.32 a. m	...do							
26	12 m....	82	72	N.	Strong...	...do	...do	12.03 p. m	.....	...do	2	4	.....	.....	.....	.....	.....
26	6 p. m..	76	76	N. E.	Gentle...	...do	...do	.....	6.52 p. m	...do							
27	6 a. m..	72	72	N. E.	...do	...do	...do	12.32 a. m	7.17 a. m	6 hauls.....	4	6	1	1	20,000	65 hours ..	.....
27	12 m....	83	79	E.	...do	...do	...do	12.54 p. m	.....								.....
27	6 p. m..	66	72	E.	...do	...do	...do	.....	7.44 p. m	7 hauls 8 p. m.....	3	7	1	2	*50,000	...do	.....
28	6 a. m..	68	72	W.	...do	...do	...do	1.32 a. m.	8.11 a. m	5 hauls 7.30 a. m..	2	3	.....	.....	.....	.....	.....
28	12 m....	73	76	S. S. W.	...do	...do	Clear ...	1.50 p. m	.....								.....
28	6 p. m..	74	74	S.	...do	...do	...do	.....	8.39 p. m	7 hauls 9.30 p. m..	6	14	3	7	†150,000	.....	.....
29	6 a. m..	72	72	S.	...do	Clear ...	...do	2.21 a. m	9.10 a. m	4 hauls 8.45 a. m..	1	3	1	1	‡10,000	70 hours ..	.....
29	12 m....	77	79	S.	...do	...do	...do	2.52 p. m	.....								.....
29	6 p. m..	72	76	N. W.	Gale	Cloudy..	Roily ...	.....	9.41 p. m	6 hauls 10.45 p. m	4	20	2	8	150,000	3 days	.....

30	6 a. m..	63	66	N.N.W.	Strong..	Clear ...	...do	3.23 a. m	.....	4 hauls 10.45 a. m .	3	13	.....	2	(§)	.....	.....
30	12 m....	77	80	N.	...do	... do	...do	3.51 p. m.	10.12 a. m.	.....	.....	.....	.....	.....	.....	.....	.....
30	6 p. m..	74	76	.....	Calm	...do	...do	.....	10.40 p. m.	6 hauls 11 p. m....	6	39	1	2	30,000	3 days	.....
31	6 a. m..	59	69	N.	Gentle...	....do	Clear ...	4.20 a. m	.....	5 hauls 11.45 a. m .	2	5	.....	.....	.....	.....	.....
31	12 m....	74	78	N.	Calm	...do	...do	4.48 p. m	11.09 a. m	.....	.....	.....	.....	.....	.....	.....	.....
31	6 p. m..	71	76	.....	...do	...do	...do	.....	11.37 p. m	6 hauls 12 p. m....	6	33	2	6	150,000	.....	.....
June 1	6 a. m..	67	72	.....	...do	...do	...do	5.15 a. m	.....	.....	3	5	.....	.....	.....	.....	.....
1	12 m....	81	75	S.	Gentle...	...do	...do	.....	12.04 p. m	5 hauls 12 m	.....	.....	.....	.....	.....	.....	.....
1	6 p. m..	70	73	S. S. E.	Strong ..	... do	...do	5.42 p. m	.....	5 hauls 12 m.....	6	19	2	4	100,000	.....	.....
2	6 a. m..	62	70	S.	Gentle..	Hazy	...do	6.09 a. m	12.31 a. m	.....	5	10	.....	.....	.....	.....	.....
2	12 m....	72	72	S.	...do	...do	...do	.....	12.58 p. m	6 hauls 1.30 p. m ..	.....	.....	.....	.....	.....	.....	.....
2	6 p. m..	64	72	S.	...do	... do	...do ...	6.36 p. m	.....	6 hauls	2	5	2	3	75,000	.....	.....
3	6 a. m..	62	69	S. E.	...do ...	Cloudy....	...do ...	7.01 a. m	1.25 a. m.	6 hauls 2 a. m.....	5	12	.....	.....	.....	.....	.....
3	12 m....	69	71	S. E.	...do ...	Clear	...do	.....	1.50 p. m.	.....	.....	.....	.....	.....	.....	.....	.....
3	6 p. m..	68	70	S. E.	...do	... do	...do ...	7.29 p. m	.....	6 hauls.....	8	25	4	6	125,000	.....	.....
4	6 a. m..	68	71	.....	Calm	...do	...do	7.56 a. m	2.13 a. m	.....	.....	.....	.....	.....	.....	.....	.....
4	12 m....	79	80	E.	Gentle...	....do	...do	.....	2.45 p. m	.....	.....	.....	.....	.....	.....	.....	.....
4	6 p. m..	78	78	E.	...do	...do	...do . ..	8.24 p. m	.....	5 hauls 2.45 p. m ..	2	7	.....	.....	.....	.....	.....
5‖	6 a. m..	64	76	.....	Calm	...do	...do	.....	3.13 a. m	.....	7	21	3	5	100,000	.....	.....
Totals.....											152	430	31	59	1,192,000	.....	1,072,800

* Washed out of boxes by gale of 29th.

† Washed out by gale of 29th.

‡ Gale washed out 150,000 eggs with fish somewhat formed, and 200,000 young fish just from eggs brought from Ferry Landing, Va. § Eggs bad. ‖ Seine "cut out".

Record of shad-hatching operations conducted at Ferry Landing, Va., on the Potomac River, from May 21, 1875, to May 29, 1875, on account of United States Commission of Fish and Fisheries, by H. W. Welsher.

[Seine 1,200 fathoms long; hauled three times every 24 hours, once on the flood-tide, twice on the ebb-tide.]

Date.	Hour.	Temperature of surface-water.	Wind.		Condition of—		Tide.		Shad taken.*	Ripe fish.	Eggs obtained.	Young shad turned loose.	Remarks.
			Direction.	Intensity.	Sky.	Water.	High-water.	Low-water.		Females.			
		°											
May 21	6 a. m..	68	W.	Gentle..	Clear	Clear	7.06 a. m	1.35 a. m..					
21	12 m....	69	W.	...do	...do	...do	.....	1.55 p. m..	860	2	60,000	.....	Eggs taken to Jackson City station.
21	6 p. m..	69	S. W.	...do	...do	...do	7.25 p. m	.....					
22	6 a. m..	70	S. E.	...do	Cloudy....	...do	7.45 a. m	2.15 a. m..					
22	12 m....	70	S.	Strong..	Clear	...do	.....	.....	801	3	90,000	.....	
22	6 p. m..	70	.....	Calm	...do	...do	8.06 p. m.	2.45 p. m..					
23	6 a. m..	70	W.	Strong..	...do	...do	8.28 a. m.	2.55 a. m..					
23	12 m....	71	W.	Gentle..	...do	...do	.....	.....	569	5	130,000	.....	
23	6 p. m..	71	.....	Calm	...do	...do	8.51 p. m.	3.17 p. m..					
24	6 a. m..	72	S. W.	Gentle..	Cloudy....	...do	.....	3.40 a. m..					
24	12 m....	72	S. W.	...do	Clear	...do	9.05 a. m.	.....	384	6	185,000	.....	240,000 eggs taken to Jackson City station, Virginia.
24	6 p. m..	72	S.	...do	...do	...do	9.37 p. m.	4.05 p. m..					
25	6 a. m..	72	N. E.	Strong..	...do	...do	9.59 a. m.	4.26 a. m..					
25	12 m....	73	N.	...do	...do	...do	.....	.....	333	10	260,000	.....	
25	6 p. m..	72	.....	Calm	...do	...do	10.24 p. m.	4.53 p. m..					
26	6 a. m..	72	S. E.	Gentle..	Cloudy....	...do	10.58 a. m	5.13 a. m..					
26	12 m....	73	S. E.	...do	Rain	...do	.....	.....	562	9	250,000	.....	
26	6 p. m..	73	S. E.	...do	...do	...do	11.13 p. m	5.37 p. m..					
27	6 a. m..	72	N.	...do	Clear	...do	.....	6.02 a. m..					
27	12 m....	73	N. E.	...do	...do	...do	11.39 a. m	.....	695	8	200,000	.....	
27	6 p. m..	74	.....	Calm	...do	...do	.....	6.29 p. m..					
28	6 a. m..	75	E.	Gentle..	...do	...do	12.07 a. m	6.56 a. m..					
28	12 m....	76	S. E.	...do	...do	...do	12.35 p. m.	.....	514	14	300,000	.....	
28	6 p. m..	76	S. E.	...do	...do	...do	.....	7.24 p. m..					
29	6 a. m..	76	S.	Strong..	...do	...do	1.06 a. m.	7.55 a. m..	.....	2	55,000	.....	
Totals.....									4,774	59	1,530,000	1,473,500	

* Seine hauled once on the flood-tide, twice on the ebb-tide.

Record of shad-hatching operations conducted at Morley Point, Md., on the Potomac River, from May 26, 1875, to June 7, 1875, on account of United States Commission of Fish and Fisheries, by Jonathan Mason.

Date.	Hour.	Temperature of—		Wind.		Condition of—		Tide.		Seine hauled.	Fish taken (males and females.	Ripe fish.	Eggs obtained.	Young shad turned loose.	Remarks.
		Air.	Surface water.	Direction.	Intensity.	Sky.	Water.	High water.	Low water.			Females			
May 26	6 a. m	66	71	N.	Fresh	Hazy	Clear	.....	5.28 a. m	11.00 a. m	3	.....	.....	.....	Two seines used.
26	12 m	82	75	N.	..do	..do	..do	11.03 a. m.	.....	2.00 p. m. to 7.00 p. m	84	8	200,000	.....	
26	6 p. m	80	72	N.	Gentle	..do	..do	.....	5.32 p. m.						
27	6 a. m	70	72	N.	Fresh	..do	..do	1.28 a. m	6.17 a. m.	3.00 a. m. to 11.30 a. m	100	1	.....	.....	Eggs all dead.
27	12 m	78	77	E.	..do	Clear	..do	11.54 a. m.	.....	3.00 p. m. to 6.30 p. m	12	2	50,000	.....	Eggs small and of glassy appearance.
27	6 p. m	72	79	E.	..do	..do	..do	.....	6.44 p. m						
28	6 a. m	67	69	E.	Light	..do	..do	12.22 a. m.	7.10 a. m.	3.00 a. m. to 8.00 a. m	150	5	100,000	.....	Bad eggs.
28	.....	.....	.....	.....	.....	.....	.....	.....	.....	7.00 p. m. to 8.30 p. m	2	.....	.....	.....	
28	12 m	80	78	E.	Light	Clear	Clear	12.50 p. m.	.....	11.30 a. m	6	1	.....	.....	Eggs all dead.
28	6 p. m	71	77	E.	..do	..do	..do	.....	7.39 p. m.	4.00 p. m. to 9.00 p. m	112	19	465,000	.....	
29	6 a. m	73	70	S.	..do	..do	..do	1.21 a. m.	8.10 a. m.	5.00 a. m. to 8.00 a. m	12	.....	.....	.....	
29	12 m	84	78	S.	..do	..do	..do	1.52 p. m.	.....	.....	.....	.....	.....	.....	
29	6 p. m	75	78	N.	Fresh	Cloudy	Roily	.....	8.41 p. m	5.00 p. m	114	12	290,000	.....	Thunder-storm 5 p. m.
30	6 a. m	62	70	N.	Strong	Clear	..do	2.23 a. m.	9.12 a. m.	6.00 a. m. to 9.00 a. m	2	.....	.....	.....	Gale of wind in the night.
30	12 m	74	78	N.	Fresh	..do	..do	2.51 p. m.	.....	.....	.....	.....	.....	.....	
30	6 p. m	74	74	N.	..do	..do	Clear	.....	9.40 p. m.	5.00 p. m. to 10.00 p. m	132	13	275,000	.....	
31	6 a. m	66	70	S.	Gentle	..do	..do	3.20 a. m	10.09 a. m.	.....	.....	.....	.....	160,000	One seine "cut out" this morn'g.
31	12 m	80	79	N.	Light	..do	..do	.....	.....	.....	.....	.....	.....	.....	
31	6 p. m	76	78	S E.	..do	..do	..do	3.42 p. m	10.37 p. m.	8.00 p. m	113	6	125,000	25,000	
June 1	6 a. m	70	72	S. E.	Gentle	..do	..do	4.15 a. m.	.....	.....	.....	.....	.....	50,000	
1	12 m	81	80	S. E.	..do	..do	..do	.....	11.04 p. m.	.....	.....	.....	.....	.....	Wind blew very hard and washed some of the eggs out of the boxes.
1	6 p. m	75	81	S. E.	Fresh	Hazy	..do	4.42 p. m.	.....	9.00 p. m	130	6	120,000	232,500	
2	6 a. m	71	73	S. E.	Gentle	..do	..do	5.09 a. m	11.31 a. m.	9.00 a. m	8	.....	.....	.....	
2	12 m	71	71	S.	..do	..do	..do	.....	11.58 p. m.	.....	.....	.....	.....	.....	
2	6 p. m	71	74	S.	Fresh	Cloudy	..do	5.36 p. m.	.....	9.30 p. m	105	6	130,000	.....	
3	6 a. m	63	70	S. E.	..do	..do	..do	6.01 a. m.	12.25 a. m	.....	.....	.....	.....	.....	
3	12 m	71	71	S.	..do	..do	..do	.....	12.50 p. m	.....	.....	.....	.....	220,000	Slight rain at 5 a. m.
3	6 p. m	71	72	S. E.	..do	Hazy	..do	6.29 p. m.	.....	.....	.....	.....	.....	.....	
4	6 a. m	63	70	S. E.	Gentle	Clear	..do	6.56 a. m.	1.18 a. m	.....	.....	.....	.....	.....	
4	12 m	78	81	N. E.	..do	..do	..do	.....	1.45 p. m	.....	.....	.....	.....	210,000	
4	6 p. m	73	79	S. E.	Fresh	..do	..do	7.24 p. m.	.....	.....	.....	.....	.....	.....	
5	6 a. m	69	71	S. E.	Gentle	..do	..do	7.51 a. m.	2.13 a. m.	.....	.....	.....	.....	.....	
5	12 m	82	80	S. E.	Fresh	Cloudy	..do	.....	2.39 p. m	.....	.....	.....	.....	105,000	Thunder-storm; heavy wind from southwest at 5 p. m.
5	6 p. m	74	80	S. W.	..do	..do	..do	8.18 p. m.	.....	.....	.....	.....	.....	.....	
6	6 a. m	71	73	W.	Gentle	Hazy	..do	8.47 a. m.	3.06 a. m.	.....	.....	.....	.....	.....	
6	12 m	80	82	W.	..do	Clear	..do	.....	3.33 p. m.	.....	.....	.....	.....	70,000	
6	6 p. m	82	84	.....	Calm	..do	..do	9.14 p. m.	.....	.....	.....	.....	.....	.....	
7	6 a. m	72	74	S.	Fresh	Hazy	..do	9.42 a. m.	4.00 a. m.	.....	.....	.....	.....	110,000	
Totals											1,085	79	1,755,000	1,182,500	

Record of shad-hatching operations conducted at South Hadley Falls, on the Connecticut River, from July 2, 1875, to July 30, 1875, on account of United States Commission of Fish and Fisheries, by C. C. Smith.

Date.	Hour.	Temperature of— Air.	Temperature of— Surface water.	Wind. Direction.	Wind. Intensity.	Condition of— Sky.	Condition of— Water.	Seine hauled.	Ripe fish. Males.	Ripe fish. Females.	Eggs obtained.	Remarks.
		°	°									
July 2	6 p. m.	80	76	S.	Light....	Clear	Clear	First haul.....	8	16	92,000	
2	.....	.....	.....	S.	...do	...do	...do	Second haul	6	20		
2	.....	.....	.....	S.	...do	...do	...do	Third haul.....	1	0		
3	6 a. m.	60	72	S.	...do	...do	...do	First haul	10	24	800,000	Absorption of heat by rocks said to increase heat of water faster than air did.
3	12 m ...	72	76	S.	...do	...do	...do	Second haul	9	20		
3	6 p. m.	76	76	S.	...do	...do	...do	Third haul.....	9	10		
4	6 a. m.	76	76	S.	.....	.....	.....	First haul.....	12	51	700,000	Spawn poor.
4	12 m ...	80	76	S.	.....	.....	.....	Second haul.....	5	12		
4	6 p. m.	79	76	S.	Strong....	Cloudy	Clear	Third haul.....	.....	.....		
5	6 a. m.	76	76	S.	Light....	...do	.....	First haul.....	12	4	158,000	
5	12 m ...	88	77	S.	...do	...do	.....	Second haul.....	10	6		
5	6 p. m.	83	77	S.	...do	Hard shower 3 to 8 p. m.	Roily	Third haul	6	4		
6	6 a. m.	88	77	S.	...do	Cloudy	Clear	First haul.....	24	35	452,000	Lightning struck box.
6	12 m ...	98	81	S.	...do	Clear	...do	Second haul.....	5	2		
6	6 p. m.	96	80	S.	Shifting .	H'd sh'w'r 4 p. m	Very roily	Third haul.....	4	1		
7	6 a. m.	82	77	S.	Light....	Clear	...do	First haul.....	23	34	632,000	
7	12 m ...	91	78	S.	...do	...do	...do	Second haul.....	4	0		
7	6 p. m.	90	78	S.	...do	...do	...do	Third haul.....	3	2		
8	6 a. m.	72	77	S.	...do	...do	...do	First haul.....	14	18	430,000	Spawn of 8th injured by roily water.
8	12 m ...	97	79	S.	...do	...do	...do	Second haul.....	2	24		
8	6 p. m.	92	79	S.	...do	...do	...do	Third haul.....	2	0		
9	6 a. m.	69	78	S.	...do	...do	...do	First haul.....	14	8	384,000	
9	12 m ...	82	79	S.	...do	...do	Clearing ..	Second haul.....	6	11		
9	6 p. m.	78	79	S.	...do	...do	...do	Third haul.....	2	5		
10	6 a. m.	67	77	S.	...do	...do	Clear	First haul.....	16	22	550,000	
10	12 m ...	78	78	S.	...do	...do	...do	Second haul.....	9	18		
10	6 p. m.	76	78	S.	...do	...do	...do	Third haul.....	3	1		
11	6 a. m.	72	77	N. W.	Very high	...do	...do	None	.....	.....	.....	
11	12 m ...	86	78	N. W.	...do	...do	...do					
11	6 p. m.	74	78	N. W.	...do	...do	...do					
12	6 a. m.	59	76	S.	Light....	...do	...do	First haul.....	13	5	236,000	
12	12 m ...	87	78	S.	...do	...do	...do	Second haul.....	1	4		
12	6 p. m.	80	78	S.	...do	...do	...do	Third haul.....	1	3		
13	6 a. m.	62	77	S.	...do	...do	...do	First haul.....	19	7	335,000	
13	12 m ...	90	77	S.	...do	...do	...do	Second haul.....	4	10		
13	6 p. m.	72	76	S.	...do	Light shower ...	.....	Third haul.....	1	0		
14	6 a. m.	77	76	N. W.	...do	Clear	.....	First haul.....	9	18	276,000	
14	12 m ...	79	77	N. W.	...do	...do	.....	Second haul.....	5	6		
14	6 p. m.	70	76	N. W.	...do	...do	.....	Third haul.....	2	4		

15	6 a. m.	80	72	S.	do	do		First haul	16	20	250,000	M. A. Green took spawn for German trip, selecting the best spawn, even throwing off light spawn from a good spawner.
15	12 m	99	79	S.	do	do		Second haul	3	5		
15	6 p. m.	83	79	S.	do	do		Third haul	3			
16	6 a. m.	70	79	N. W.	Moderate	Cloudy		First haul	11	*15	150,000	
16	12 m	72	78	N. W.	do	Rainy		Second haul	1	5		
16	6 p. m.	57	78	N. W.	do	do						
17	6 a. m.	65	76	N. W.	Light	Clear		First haul	5	11	130,000	
17	12 m	72	77	N. W.	do	do		Second haul	12	5		
17	6 p. m.	66	78	N. W.	do	do						
18	6 a. m.	62	76	N. E.	do	Raining		First haul	4	21	310,000	
18	12 m	62	75	N. E.	do	do		Second haul		*6		
18	6 p. m.	60	76	N. E.	do	Clear						
19	6 a. m.	64	74	N. W.	do	do	Clear	First haul 8 p. m	7	6	47,000	Only one good male.
19	12 m	65	75	N. W.	do	do	do	Second haul		4		
19	6 p. m.	81	72	N. W.	do	do	do	Third haul 10 30 p. m				
20	6 a. m.	53	72	S.	do	Cloudy	do	First haul	3	4	93,000	
20	12 m	59	75	S.	do	do	do	Second haul	1	8		
20	6 p. m.	72	73	S. W.	do	do	do	Third haul	1	6		
21	6 a. m.	63	73	S. W.	do	do	do	First haul	3	5	125,000	
21	12 m	80	76	S. W.	do		do	Second haul				
21	6 p. m.	72	76	S.	Strong	Shower	do	Third haul	1	8		
22	6 a. m.	61	76	S.	Light	Clear	do	First haul	2	4	220,000	
22	12 m	85	77	S.	do	do	do	Second haul	1	3		
22	6 p. m.	76	77	S.	do	do	do	Third haul	4	12		
23	6 a. m.	76	76	N. E.	Moderate	Rain	Rainy	First haul	3	13	132,000	
23	12 m	73	75	N. E.	do	do	do	Second haul				
23	6 p. m.	66	74	N. E.	do	do	do	Third haul				
24	6 a. m.	63	72	N. W.	do		Clear	First haul	1	8		
24	12 m	85	76	N. W.	do		do	Second haul		6		No good milt.
24	6 p. m.	71	76	N. W.	do		do					
25	6 a. m.	67	74	N. W.	Slight	Clear	do					
25	12 m	93	75	N. W.	do							
25	6 p. m.	83	76	N. W.	do	Rain						
26	6 a. m.	64	76	S. E.				First haul	6	8	187,000	
26	12 m	85	76	S. E.				Second haul	4	11		
26	6 p. m.	72	76	S. E.				Third haul	1	10		
27	6 a. m.	72	75	N. W.		Cloudy		First haul			54,000	
27	12 m	90	75	N. W.		do		Second haul	3	12		
27	6 p. m.	84	75					Third haul	4	2		
28	6 a. m.	66	76	N. E.				First haul	4	6	70,000	
28	12 m	85	76					Second haul	2	8		
28	6 p. m.	72	75									
29	6 a. m.	60	76	S.								
29	12 m	81	76	S.								
29	6 p. m.	72	76	S. E.		Light rain						
30	6 a. m.	71	75	S.		Clear						
30	12 m	84	75	S.								
30	6 p. m.	76	76									
Totals									374	653	6,893,000	

*Extra good. †Not good. ‡Spent.

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