XX.—REPORT OF WORK AT THE UNITED STATES HATCHERY, NORTHVILLE, MICH., 1881-'82.

By FRANK N. CLARK.

The following report, in connection with the work of this station, for the year ending June 30, 1882, is respectfully submitted.

The work performed during the period covered by this report includes the collection and subsequent disposition of the eggs or fry proceeding from 22,500,000 eggs of whitefish (*Coregonus albus*); 140,000 eggs of brook trout (*Salvelinus fontinalis*) from the ponds of this station; about 5,000 eggs of the red-banded or rainbow trout of California (*Salmo iridea*), also from the ponds of this station, and 57,000 eggs of lake trout (*Cristivomer namaycush*); the forwarding of 75,000 eggs of California trout received from the United States station at Baird, Cal., and the care and disposal of the resultant fry; the forwarding of 46,500 eggs of Schoodic salmon received from the United States station at Grand Lake Stream, Me., and the distribution of the fry; and the distribution of 1,500 young carp received from the national carp ponds at Washington.

In addition to this work, the old trout ponds were reconstructed and reoutlined during the months of September and October, and an additional pond built to accommodate the increased stock of breeders. A survey of the premises was made in July, and a map of the same, showing the proposed improvements, was soon after submitted to the United States Commissioner.

For the purpose of creating a large stock of parent fish from which to supply the increasing demand for eggs of California trout, several thousand of the young of these fish were retained from the lot hatched in February and March of the present year, and 12 new tanks fitted for their temporary accommodation. Anticipating the increased accommodations required by these fish later on, excavations for three new ponds were begun in April, and these are now nearly completed.

During the first two months of the year under consideration—July and August—no special work was carried forward, the time being occupied with work that is, for the most part, current throughout the year. This includes the preparing and dispensing of aliment to the growing and adult fish; devising and executing plans for their protection from poachers; affording to the relatively smaller fishes protection

from their greatest enemies—the larger ones—by keeping them assorted according to size, irrespective of age; directing and equalizing the inflow of water proportionate to the number and size of the fishes in each pond; guarding all possible avenues of escape of the fishes from one pond to another, as well as into the waste channel, and in removing the masses and collections of the ever-generating algæ floating against and clogging the screens—a source of great annoyance on hot, sunny days that are especially favorable to its formation.

At the hatchery, but little preparation for the hatching season was necessary, everything having been put in order at the close of this branch of work in April, 1881, and left in readiness to resume operations again at the proper time. The few essential preliminaries in this direction, as well as in connection with the water facilities and adjuncts, were therefore arranged in September and October, cotemporaneously with the work of revising the trout ponds.

As the estimates contemplated increased work in the way of propagating whitefish, increased hatching capacity was provided by displacing a double row of hatching-boxes with a tier of tanks, which were subsequently equipped with hatching-jars.

Possible and manifestly weak places in connection with the spring pond and its three outlets were repaired and strengthened to better guard against leakage and imminence of danger of outbursts. The discharging channels alluded to provide for drainage, for overflow, and for conveying the water to the reservoir from which the tank room is supplied. Being made of wood and laid underground, they have usually lasted not to exceed 4 or 5 years, and, in spite of their being thoroughly caulked when laid, leak more or less after a time. Then, the draught-pipe between the spring pond and reservoir must, of necessity, pierce the dam near its surface to give sufficient head of water in the hatchery, and, being so near the surface, has been lifted from its bed by upheavals of frost, the water percolating underneath. The overflow being still nearer the top of the dam is even more liable to be thus forced from position; and nothing short of constant vigilance at times has prevented the water getting sufficient start in this way to wash a gorge across the highway that creates the dam, which would soon draw the pond below the draught pipe, and thus discontinue the supply for the hatchery. The overflow in use having become quite unserviceable through age, I decided to guard against further insecurity at this point by replacing it with pipes of iron firmly imbedded in cement and gravel. This was accordingly done, and no further trouble from this source is anticipated. The drainage and draught pipes, after being thoroughly caulked, were considered safe for another season—the one just closed. But as there is now more or less leakage, which is a constant menace to the safety of the dam, and as it is important to secure immunity from danger of destroying the water power during the hatching period, these must also be replaced by iron conductors of sufficient caliber for the purpose,

surrounded by an impervious mass of cement and gravel. Until this is done it will not be possible to command the entire yield of the supplying springs, nor to dictate through what channels the water shall be discharged.

The cooling or intermediate reservoir between the spring pond and hatchery had been leaking quite too freely to be compatible with safety, so that repairs were considered essential. We therefore girted it with a 10-inch band or rim of 2-inch planking, the water level touching the middle of the rim, while the planks themselves are firmly held against the outer wall by spikes driven to stakes set in front. Then, a double coat of cement, lapping on the edge of this rim and covering the entire interior surface of the reservoir, was spread, thus effectually closing all possible chances for leakage. The test of eight months' use of this receptacle has shown it to be absolutely water-tight and perfectly safe.

NOTES AND TABLES IN REFERENCE TO COLLECTING THE SUPPLY OF WHITEFISH EGGS.

Most of the eggs laid in were secured at the "Bass" islands of Lake Erie, which are, on the whole, quite as reliable as any locality for this work. Certain other points in Lake Erie, as well as in Lakes Huron and Michigan, may show heavier catches of fish, but they are, so far as I have been able to ascertain, less prolific of ripe fish, in proportion to the number caught. At the islands, too, as well as at all other points, the yield of eggs from the various fisheries is quite disproportionate to the catch of adult fish. The fact that whitefish are caught in any given locality during their nominal spawning period does not necessarily signify that ripe fish will be found at such places, for the devices for their capture—the stationary trap net or portable gill-net—may not be set on or near those grounds naturally selected by the fish for the deposition of spawn, but at points in the paths or runways leading to and quite remote from the objective point of the fish in their migrations from the feeding to the spawning grounds. From these nets ripe fish are found, if at all, with the exception of an occasional straggler, in the later runs at the last of the season. Such fisheries, although quite profitable for the fishermen, are generally unreliable for the collection of spawn, especially when adverse weather compels a suspension of work before the last migrations occur.

There are certain spawning grounds in the vicinity of the islands that can invariably be depended on. These are well known, and have become favorites with the spawn-gatherers, not only because of their reliability and certainty of being visited by schools of ripe fish, but ripe fish usually appear several days earlier than at other points, some of which furnish heavier catches. Indeed, the privilege of collecting eggs from the nets set on these fruitful grounds is so much sought after by the representatives of various fish commissions that, naturally enough, considerable rivalry for the control thereof is developed. Naturally

enough, too, the State commissions can wield a greater influence than others over net-owners, their work being practically of a local character, and carried on for the express purpose of increasing the stock of fishes by propagation.

Notwithstanding this opposition, however, I arranged with Messrs. Snide and Fox, of North Bass Island, for the eggs from their three trap-nets, which were established on spawning grounds not surpassed by any in Lake Erie. Fourteen and a half million eggs were taken from these three nets, or nearly 5,000,000 to the net, as will be seen by referring to the tables. A glance at the tables will show also that eggs were taken here seven days earlier than at Middle Bass Island, and eight days earlier than at Kelley's Island.

Four nets were worked at each of the last two islands mentioned, the former yielding 1,000,000 to the net and the latter about 650,000.

During the fall season whitefish and herring comprise the great mass of fish caught at the islands, or, for that matter, throughout Lake Erie. Indeed, the combined catch of all other kinds is insignificant in comparison.

The lake remained open much later than the preceding season (1880), increasing the product of the fisheries to correspond. Notwithstanding this, however, the greater demand and brisker competition of buyers combined to produce a decided advance in prices. Thus in the fall of 1880 the fishermen received 3¼ to 3½ cents per pound for whitefish and 50 cents per hundred weight for herring, while during the period under consideration they received 4¼ to 4½ cents for whitefish and 75 cents to $1 for herring.

Pending the appearance of ripe fish the "egg-man" must bide his time with patience, disposing of the time which would otherwise hang heavily in collecting notes by the wayside, and making frequent tours of the docks as the fish-boats come in to note the condition and catch of fish, often being compelled, through courtesy, to listen to the oft-repeated tale of some superannuated fisherman, who tells what "piles" of fish *he* used to catch in "them days," such fabulous figures being noted as to induce the belief that the original number had increased in geometrical progression through the intervening years.

Following are the tables of spawn-taking operations at North Bass, Middle Bass, and Kelley's Island:

AT NORTH BASS.

Date.	Females used.	Males used.	Number eggs taken.
Nov. 10	1	3	15,000
11	4	10	45,000
13	12	18	250,000
14	34	50	640,000
16	49	60	960,000
18	45	80	950,000
20	50	70	1,000,000
21	90	120	2,000,000
22	53	100	1,250,000

AT NORTH BASS—Continued.

Date.	Females used.	Males used.	Number eggs taken.
Nov. 23	40	65	900,000
26	58	85	1,250,000
27	85	110	1,825,000
28	20	25	375,000
29	24	34	450,000
30	28	40	500,000
Dec. 1	26	50	450,000
2	38	45	800,000
3	20	25	440,000
4	18	22	300,000
5	6	9	100,000
Total			14,500,000

AT MIDDLE BASS.

Nov. 17	18	35	400,000
18	16	35	325,000
20	30	50	550,000
21	18	32	325,000
23	32	48	650,000
26	40	55	725,000
27	20	60	475,000
28	22	38	450,000
30	6	13	100,000
Total			4,000,000

AT KELLEY'S ISLAND.

Nov. 18	6	10	125,000
19	5	10	75,000
20	10	18	200,000
22	16	28	300,000
23	42	70	850,000
25	25	40	450,000
26	21	36	400,000
Dec. 1	4	10	100,000
3	4	9	75,000
Total			2,575,000

The eggs were packed and conveyed to the hatchery in the flannel-tray shipping-cases, substantially in the same manner noted in my last report (1880–'81).

At Alpena, Mich., whence I anticipated receiving a large number of eggs, a very decidedly off year for the fishermen, and in consequence for the spawn-gatherer, was experienced. The continued warm weather of October and November delayed the cooling of the water to that degree necessary to drive the fish from the deep waters to the shoals and reefs for the purpose of spawning, until near the usual time for winter to set in; so that the fishermen, fearing a repetition of the experiences of the preceding season, when winter was precipitated upon them so suddenly that a large amount of fishing appurtenances were frozen in and destroyed, entailing heavy losses, were affrighted at the first cold snap, and had relegated all their paraphernalia to winter quarters before the ebb-tide of whitefish—the fisherman's bonanza—had set in.

In this section the first runs during the fall season are made up almost wholly of lake trout (*Cristivomer namaycush*), and usually a sufficient number are caught to compensate for cost of fitting up and setting the nets and current operating expenses, leaving the measure of profits to be determined by the length of time the work can hold out against the weather during the whitefish run. This would seem to be and invariably is sufficient inducement to incur the taking of great risks; but the fishermen seemed only to remember the disasters and losses of the previous season, forgetting that the early and intense cold of that period was quite exceptional. A feeling of overcaution was produced, manifested by the great haste of interested parties to consign their trappings to the protection of harbors and twine-houses. But as day after day of moderate weather—for the time of year—followed the first blizzard, they saw how premature their alarm had been, and it is safe to predict for the coming season a relapse into the other extreme of an entire disregard of the premonitions of winter.

The season could doubtless have been made a successful one for both fisherman and spawn-taker, as the weather was such as to admit of a continuance of operations long after the field was abandoned. Even as it was, fishing was carried on ten days later than last year, but should have continued still fifteen days longer to correspond with the weather and runs of fish. The number of whitefish actually brought to port at Alpena during the season was quite insignificant compared with some former years, and a very decided falling off from the average. Of course quite a large number were caught in the aggregate, from which many millions of eggs might have been obtained had there been a heavy sprinkling of ripe spawners; but only the advance guard was captured, and this is invariably made up of a great preponderance of males—mostly ripe—and a few unripe females. Just as mature spawners began to appear, a brief period of severe weather came on, nets were withdrawn as rapidly as possible, so that eggs were taken only on four days, and then in insignificant numbers, with one exception. In no other branch of the work is success or failure so dependent upon and associated with the condition of the weather.

Certain well-known and well-defined localities are sure to receive the annual visitations of hordes of whitefish laden with spawn; but as the climax of their spawning period is reached only at the verge of winter, when the elements are liable at any time to combine to prevent their capture, a considerable degree of uncertainty in regard to laying in a very large number of eggs is of necessity unavoidable.

However, I can but regard Alpena and vicinity as a favorable locality for the collection of whitefish eggs. Large numbers of the parent fish are captured, and very rarely, indeed, are the fisheries abandoned before the height of the spawning season is reached. This fact, coupled with the great fecundity of the fish, makes it a matter of comparative ease to obtain vast numbers of eggs under favorable circumstances. Having

plenty of ripe fish at command, one man can readily take two or three million eggs daily. I have taken, on more than one occasion, under partial adverse circumstances, 2,000,000 eggs in a day. It will be seen, then, that but few days in the aggregate, *at the right time*, are required to secure great numbers. Indeed, taking the seasons as they average, only a small corps of spawn-gatherers are necessary to collect any reasonable number of eggs.

Mr. Wires, with one assistant, obtained eggs as follows:

Nov. 16	25,000	from 2 females.
Nov. 19	100,000	from 6 females.
Nov. 20	100,000	from 7 females.
Nov. 21	200,000	from 11 females.
Nov. 22	1,000,000	from 40 females.

Those taken November 16 were from trap-nets, the remainder from gill-nets. Besides the 1,425,000 whitefish eggs taken and sent on to Northville in good condition by Mr. Wires, some 60,000 eggs of lake trout were taken from 10 spawners on the last day of October, and forwarded to Northville in good shape the day following.

Below is Mr. Wires's record of temperatures and weather observations made each day at 12 m.:

Date.	Temperature of air.	Temperature of water.	Direction of wind.	Intensity.	Condition of sky.	Remarks.
1881.	°	°				
Oct. 28	48	50	S.	High	Cloudy	Raining nearly all day.
29	56	50	SE.	do	Clear	Went out with fishing tug Seawing.
30	46	50	W.	Fresh	Cloudy	Do.
31	48	50	N.	Light	Clear	Do.
Nov. 1	50	50	S.	do	do	Remained at Alpena.
2	49	49	SE.	Fresh	Cloudy	Went out with the Seawing.
3	41	48	SW.	Strong	do	Light snow-storm. Visited Partridge Point fishing grounds.
4	30	47	NW.	do	do	Raining. Aboard the Seawing.
5	34	47	NE.	do	do	Stormy. At Alpena.
6	54	47	S.	Fresh	Clear	Went to Scarecrow Island.
7	50	47	SE.	do	Cloudy	Went to North Point.
8	49	47	S.	Very strong	do	Blowing a gale; no nets lifted.
9	46	46	W	Strong	do	At Alpena. No spawning white-fish found yet.
10	38	46	W.	Fresh	do	Do.
11	39	46	E.	Light	do	Do.
12	43	46	W.	Strong	do	Squally. Aboard the fishing tug Grayling.
13	41	45	NW.	Light	do	At Alpena.
14	38	44	SW.	Strong	do	Snowing. At Partridge Point.
15	26	40	W.	do	do	Went to fishing grounds at Ossineke.
16	36	40	W.	Light	do	First eggs of white-fish taken at Ossineke.
17	48	40	SW.	Very strong	do	Blowing a gale; no nets lifted.
18	30	39	W.	Strong	do	Trap nets being taken up at Ossineke.
19	30	38	N.	do	do	Cold rain and sleet. Aboard the Seawing.
20	24	37	SW.	do	do	Storming. Aboard the Seawing.
21	30	37	NW.	do	do	Do.

Date.	Temperature of air.	Temperature of water.	Direction of wind.	Intensity.	Condition of sky.	Remarks.
1881.	°	°				
Nov. 22	25	36	SE.	Light	do	Aboard the Tom Merrill.
23	46	36	SW.	Very strong	do	Blowing a gale. Boats remained in port.
24	18	34	W.	Strong	do	Do.
25	24	33	SW.	do	do	Blowing strong. Boats remained in port.
26	30	33	NW.	do	do	Went out with the Tom Merrill. Fish in nets mostly dead; nets not reset.
27	23	32½	NW.	do	do	At Alpena. Nets of all kinds being withdrawn as fast as weather will permit.
28	35	32½	S.	do	Clear	Do.
29	48	32½	SW.	do	do	Do.
30	34	32½	E.	Light		Squalls of snow and sleet.

NOTE.—Left Alpena for Northville December 2, arriving the day following.

OPERATIONS AT THE HATCHERY.—DISTRIBUTION OF EGGS AND FRY.

Twenty-two million five hundred thousand eggs were shipped from the spawning grounds, all arriving at the hatchery in good condition. The first lot came from the islands November 21, and the last lot from the same source December 8. Upon arrival the eggs are washed from the trays of each case successively into a tub of water, and dipped thence with a skimmer into the hatching jars. All the jars on hand were filled before the last shipment of eggs but one came to hand from the spawning grounds. Pending the arrival of a number of jars daily expected, the eggs of this lot were allowed to remain in the shipping cases, which were placed in a room varying in temperature from 38° to 55°. The jars soon came along, but some little time was consumed in fitting them up for the reception of eggs; so that ten days had elapsed from the time the eggs were arranged in the cases at the islands until their removal therefrom at the hatchery, yet no special loss on this account was shown. Up to this time the eggs remained nearly intact, although conferva had begun to develop from the dead eggs. However, a few matted chunks adhered to the trays when emptied, and these, with others rapidly forming, would soon have caused serious loss had they been allowed to remain undisturbed much longer.

For experiment, we took from this lot of eggs as soon as they reached the hatchery about 25,000, and placed them in a hatching box, where, of course, the water is constantly renewed, but the eggs themselves lie nearly or quite motionless on the trays. Here we allowed them to remain 7 days without removing the dead eggs. At the end of this time they had collected in masses and bunches, scarcely any remaining that were not held by the outreaching fingers of conferva. Fully one-half were already destroyed, and we succeeded in saving a portion of the

remainder only by agitating the collections and chunks violently in water, passing the freed eggs through a sieve. The results serve only to verify prior experiments, which show that the greatest enemy of the egg—conferva—generates much faster in water than in atmosphere of the same or even a higher temperature, and that in consequence eggs are far safer out of water than in unless provision for the removal of the confervaceous egg is made. For incubating the eggs, the Chase automatic jar was used, 136 being required at first. They were arranged as follows:

84 jars, at 175,000 each	14,700,000
52 jars, at 150,000 each	7,800,000
	22,500,000

The number of eggs the jar will contain while in operation is in an inverse ratio to the volume of water used. When the minimum of water is used, or just barely enough to impart sufficient motion to the eggs to keep them detached, the jars will hold 175,000 eggs each. Well-filled jars, with a gentle circulation, work much better than those partially filled and given a brisk or violent action; in fact, the former show the very best movement obtainable. But jars to be operated in this way must be perfect in form and have evenly ground tubes, otherwise no motion whatever will be imparted to a portion of the eggs. Then, too, if there is a considerable sprinkling of dead eggs—frequently the case at the beginning of the season—a gentle movement will not always prevent the putrid eggs from uniting or collecting in chunks or masses, which will settle to the bottom of the jar instead of being thrown off. For this reason "Hospital" jars have to be given a liberal supply of water in the shape of very energetic currents.

Several experiments were made with a view to improving on the hatchers in use. The "Improved Shad Hatcher," described in Forest and Stream of June 16, 1881, was tried and found to give a more perfect movement to the eggs than the Chase jar. To secure this, however, either a greater volume or head of water was required, owing to the force of the current as it entered the jar being partially arrested in the hollow of the upright cup or cone.

To overcome this drawback, Assistant Bower advised the use of a solid double cone, the inverted section of which would simply divert or radiate the water without breaking its force, and by its own weight retain its position. The suggestion being acted upon, an equalized current compelling a uniform and perfect movement of the eggs was produced, with the minimum supply of water.

Into this jar or hatcher the water is introduced at the bottom; in the Chase jar at the top, being directed to the bottom by a glass tube resting on feet, which frequently obstruct and disconcert the currents throughout the egg-chamber. Assistant Wires succeeded in amending this defect, thereby greatly improving the efficiency of the Chase in-

strument, by using a tin tube with a wide flange or rim at the bottom, conical in shape to conform to the lower section of the above-mentioned double cone over which it was set, the cone being inverted so that the strips of tin serving as feet when used with the other jar, would raise the tube to allow the water to escape uniformly from the outer edge of its flange or rim.

Mr. Bower also fitted up a rectangular box or tank for an incubator, so constructed that the eggs rise from the center and settle down the outside, exactly reversing the jar movement. It is 12 inches wide, 13 deep, and 30 long, although its length might be extended indefinitely without disturbing or changing its operation. It is divided into upper and lower sections, and, as with the jars, a water-pressure or head is required. The desired movement of the eggs is obtained by introducing the water into the lower section, whence it is admitted to the upper section, which is the egg-chamber, through a sixteenth-inch crevice running lengthwise of the box. From either side and 6 inches from the top the partition which divides the box into two sections slants downward to converge the eggs to the center where the current forced through the crevice carries them up again to settle back, fountain-like, as before. Overflows with wire gates are provided at intervals around the top of the box. This apparatus was not tried until the eggs had already begun hatching, so that no opportunity to correct its faults by a practical test was given. It worked very well, however, although after trying it we were well satisfied that it should be given greater depth, less width, and a greater head of water. Doubtless a little more experimenting with this or a similar device will produce an incubator that will be entirely satisfactory, as the principles by which the water currents are obtained and controlled are correct; while it would have the merit of being easily operated, and furnishing capacity for many millions of eggs at a merely nominal cost.

Spring water alone is used for hatching purposes at this station, and where it first issues from the earth varies but little from a temperature of 47°. In consequence of the very moderate weather which prevailed the past winter, our arrangements for securing a lower temperature—continued exposure to the air before reaching the hatchery—were of little avail. The eggs, therefore, progressed very rapidly from the first until all were hatched.

The first orders for whitefish eggs to be filled were from Herr von Behr and G. Ebrecht, Germany. The eggs were packed in separate cases and started on their journey December 19, consigned to Fred. Mather, Newark, N. J., whence they were reshipped to destination. These and subsequent lots were prepared for shipping substantially as follows: First, a sufficient number of trays of canton flannel are made, also a substantial case for the same, of the proper size to allow 4 to 6 inches space all around for the packing material. The trays are then anchored in a tank of water. A quantity of eggs are transferred from

the hatching vessels to a number of wire trays in the picking trough, and carefully feathered over to show up the dead and unimpregnated eggs, which are removed with nippers. After collecting the eggs by overturning and submerging the trays into a large tin vessel partially filled with water, they are skimmed up and measured in an 8-ounce graduate (equivalent to 10,000 eggs) and poured thence into the shipping trays. These are then removed to the packing room, or where the temperature is between 30° and 40° Fahrenheit, tilted and drained, and the eggs spread with a feather uniformly two layers in depth, a half inch margin being left around the outside. A single fold of dampened millinet is then thrown over the eggs, and a sufficient quantity of live moss, previously picked, washed and wrung out just enough to prevent dripping or drainage, piled on to fill the tray when rather snugly pressed down. When practicable, the trays are allowed to stand a few moments in a temperature of 27° to 32°, or until needles of ice have begun to form in the moss, then placed one above the other and firmly held to position by cleats nailed to top and bottom boards. The package is then transferred to the shipping case, having a 4-inch coating of fine, dry, hardwood shavings in the bottom, and surrounded with the same material quite firmly pressed in. The case is now soon ready for its journey, not, however, until the usual printed instructions and precautions to express messengers are pasted to the cover, and which, if observed and heeded, would deliver the eggs to consignees in practically the same condition as when packed ninety-nine times out of a hundred.

Following is the table of shipments:

Date.	Number of eggs shipped.	Consignees.
1881.		
December 19	300,000	F. Mather, Newark, N. J., for von Behr, Germany.
19	12,000	F. Mather, Newark, N. J., for G. Ebrecht, Germany.
23	250,000	B. B. Redding, California.
24	250,000	Do.
31	10,000	Prof. S. F. Baird, Washington, D. C.
1882.		
January 7	250,000	F. Mather, Newark, N. J., for France.
13	500,000	B. F. Shaw, Iowa.
16	10,000	H. J. Fenton, Connecticut.
23	250,000	B. B. Redding, California.
31	100,000	Prof. S. F. Baird, Washington, D. C.
31	100,000	Mrs. J. H. Slack, New Jersey.
Total	2,032,000	

I am unable to report the condition in which the transatlantic shipments reached their destination, correspondence relating thereto having been made directly with the United States Commissioner, or with Mr. Mather. Indirectly, however, or from Circular No. 1, 1882, of the German Fishery Association, I learn that the whitefish eggs arrived "in the very finest condition, fine beyond comparison"; from the same source,

also, that of the 20,000 lake trout eggs shipped from Northville, December 10, "only 100 were dead."

Mr. Redding reported that the two lots of a quarter million each, shipped December 23 and 24, arrived at San Leandro, Cal., ten days later, in rather poor condition; accounted for in part by their having taken the Southern Pacific Road, which passes through a warmer climate, besides being four days longer in transit than if they had gone over the Central Pacific. The third quarter-million lot, consigned from Northville January 3, arrived at San Leandro in very good condition. Mr. Woodbury, superintendent of the San Leandro hatchery, reported the hatching of 90 per cent. of this lot, and about 35 per cent. of the others, the fish being planted as follows:

Jan.	19—Donner and Tahoe Lakes	75,000
	30—Shafters Lake (Marin County)	5,000
Feb.	1—Clear Lake, Lake County	75,000
March	7—Concow Lake, Butte County	10,000
	4—Lake Tahoe, Placer County	100,000
	9—Clear Lake, Lake County	100,000
	10—Radcliff Lake, Santa Cruz County	20,000
	11—Lake Chabot, Alameda County	5,000
		390,000

Mr. B. F. Shaw, Commissioner of Fisheries, reported that 75 per cent. of the eggs sent him for the State of Iowa hatched, and that the minnows were released in Lake Okibozi and Spirit Lake, Iowa.

Mr. Fenton reported that the 10,000 eggs forwarded him for the State of Connecticut arrived January 20, and upon opening the package about 2,000 of them were found frozen to death. The subsequent loss was a little over 900, leaving about 7,000 fish, which were set free in Long Lake, Litchfield County, Connecticut.

Mr. Anderson, who had charge of the hatchery of the New Jersey Commission, in which the eggs consigned to Mrs. Slack were developed, reported that the eggs reached Bloomsburg February 3, at 4.39 p. m., in very good condition. About 90 per cent. were hatched by the 11th of February, or 90,000 fish in all, of which one-half were liberated in Shepherd's Lake, and the remainder in Greenwood Lake.

At the Northville hatchery the fish began hatching from the oldest eggs January 27, and all were out by the 25th of February. At least three-fourths of them hatched between the 6th and 12th of the latter month, taxing the capacity of the receiving tanks to their utmost. Perforated tin boxes are fitted to these tanks near the overflows, to keep the fish away from the currents at that point, which would be too strong for them to resist. They are also provided with compartments which are supposed to catch the shells; but while the fish were hatching so freely, a sufficient number of shells would float over these divisions to

clog the screen-boxes every few moments, so that unremitting attention was demanded day and night to keep the outlets unimpeded.

The United States Fish Commission car, with Messrs. Ellis, Moore, and Simmons to assist in the work of distributing and planting the minnows, reached Northville February 3. Arrangements for the gratuitous transportation of the car and its messengers having previously been made with all the railroad companies, with one exception, whose lines were to be traversed, the distribution proceeded smoothly and with little expense from the initial trip, February 7, until the successful termination of the work, March 2. Much credit is due Mr. Ellis, who had charge of the trips, and also to his experienced assistants. The car itself was also a great convenience, as well as an important and efficient factor in carrying forward this work.

Following are the railroad companies to whom acknowledgments are due for free transportation of car and messengers: The Flint and Pere Marquette; Michigan Central; Chicago and West Michigan; Milwaukee, Lake Shore and Western; Chicago and Grand Trunk; Great Western; Rome, Watertown and Ogdensburg; and Lake Shore and Michigan Southern.

Table of distribution.

Date of deposit.	Number of fish released.	Point of deposit.	Waters in which the fish were set free.
February 7	1,500,000	Saint Joseph, Mich	Lake Michigan.
8	1,500,000	Muskegon, Mich	Do.
13	2,000,000	Port Huron, Mich	Lake Huron.
16	1,750,000	Racine, Wis	Lake Michigan.
16	1,750,000	Sheboygan, Wis	Do.
21	3,500,000	Oswego, N. Y	Lake Ontario.
24	3,500,000	Islands of Lake Erie	Lake Erie.
28	1,000,000	Ludington, Mich	Lake Michigan.
March 2	1,250,000	Detroit, Mich	Detroit River.
Total	17,750,000		

TROUT-WORK.

When the trout-ponds in connection with this station were established the stock of breeding fish was comparatively small, and the ponds themselves were mere excavations irregularly outlined. At the beginning of the year under consideration the embankments were quite unsafe, having been burrowed and undermined by muskrats, while the pond-room was quite inadequate to properly accommodate the increased stock of fishes. The work of enlarging and otherwise improving them, and the construction of an additional pond and new raceways, was therefore begun in the latter part of August and carried forward to completion by the last of October, or barely in time to give the ripening spawners undisturbed possession of the new premises during their spawning season. Three new ponds were also built the following spring, as before noted, making 7 altogether, 6 of which are 83 by 20 feet, and the other 51 by 14, showing a total pond area of 10,674 square feet.

The ponds are planked all around, the planks being spiked to stakes driven in front. Between and around all the ponds, and of the same height as the planking, is a pier of earth 8 feet wide, and across this are laid pieces of 2 by 4 firmly spiked to the stakes to which the planks are nailed. Being thus secured it is quite impossible for the earth to cave in or the sides of the pond to bend in or out. The bottom plank is set in a bed of gravel and blue clay, and a heavy body of the same material, well champed in, backs the planking up to the top of the pier, so that the ponds are practically water-tight, while the efforts of musk rats to invade them by burrowing underneath will be futile. Each pond is usually filled to within a foot of the top, the bottom sloping gradually from the head, where the water is 18 inches in depth, to the foot, where it is 4 to 5 feet. The overflow gates of the discharging flumes are easily raised by a lever attachment at the bottom, so that the water can be drawn off in a few moments. The gates are made in sections, one or more of which can be removed to give any desired depth of water.

As quite a number of fish will spawn in the ponds instead of running up the raceways, if the former have gravel bottoms, which they should have, those in which the breeders are placed during the spawning season are divided into two sections by a temporary partition, and the bottom of the upper section covered with boards. The fish all being placed in this, but few, if any, eggs will be lost, and as fast as the fish are handled from the raceways they are transferred to the lower section. At the close of the spawning season the partition is removed.

At the mouth of the flume connecting the upper section with the raceway a trap-gate, sprung with a string leading to the hatchery, is fitted, a simple but very useful device, for no matter how stealthily one approaches, nor from what direction, some of the fish in the raceway will detect the movement and dart back to the pond before the gate can be dropped to head them off.

The fish are given access to the raceways at all seasons of the year, and hither they resort largely at other than spawning time. A raceway fed directly from a copious spring of cold water, and given sufficient fall to create a sparkling current over its clean, gravelly bottom, affords an attractive "summer resort" to trout having admission to it, and here, in warm weather, many of them congregate, lying nearly motionless, with head up stream, for hours together. At the approach of cold weather, when an equally satisfactory temperature is found in the ponds, this practice is discontinued, except with the ripening females, which, with a heavy body-guard of males, and in response to that instinct which impels them to deposit their eggs in a current, begin to prepare spawning beds in the raceway, whence they are easily captured at the proper time for the purpose of expressing their eggs.

The breeding fish are quartered in ponds nearest the feeding springs for some time preceding the spawning season, and, when most convenient, continuously. This gives them the least variance of temperature

obtainable, and ripens them at about the same time each season, there being but little fluctuation of temperature in these ponds at corresponding periods of one year with another.

The spawning season therefore opens almost invariably from the 1st to the 5th of November, and closes practically from the 10th to the 15th of January, although much the greater portion of the fish spawn from the middle of November to the middle of December. During the past season, perhaps a half-dozen spawned later than the latest date mentioned, and from one of these eggs were not taken until February 2.

Some 140,000 were taken altogether. The first 120,000 turned out very well, a loss not to exceed 10 per cent. occurring during incubation; but the last 20,000 showed a loss of 50 per cent., due to the plan of handling the fish from which they were taken. A majority having spawned, we placed the remaining fish in the raceway, and carefully examined them every morning. As a result of this repeated dipping up and inspection of the fish for several mornings in succession, we were compelled to pick away quite half of the eggs so taken—which is pretty good evidence that the less the fish are disturbed or manipulated while ripening, the better the eggs produced.

The following statement accounts for the disposition of the eggs and fry:

Total number eggs taken		140,000
Loss during incubation	22,000	
January 10, shipped to F. Mather, for reshipment to France	20,000	
January 24, shipped to Druid Hill hatchery, Baltimore, Md	30,000	
		72,000
Number fry hatched		68,000
March 8, planted in Washtenaw County, Michigan, in spring brook tributary to river Rouge		10,000
March 15, planted in spring brook near the Northville hatchery, and tributary to river Rouge		10,000
May 8, shipped per United States Fish Commission car, in charge of J. F. Ellis		30,000
Loss on fry since hatching		8,000
Fry now on hand in nursery tanks		10,000
		68,000

Average period of incubation, 84 days.

As our breeding force of brook trout will receive large accessions next fall from the stock of growing fishes, we confidently expect to take at least a half million eggs during the next spawning season.

HATCHING AND DISTRIBUTION OF CALIFORNIA TROUT.

On January 24, Mr. Myron Green, of the United States station at Baird, Cal., consigned to the Northville hatchery a case containing 45,000 eggs of the rainbow trout, and on February 6 a second lot of 30,000. The first shipment reached Northville February 2, and the last February 14, both in excellent condition. Number of dead eggs picked from first lot on arrival, 615; from the last, 272; subsequent loss on eggs, about 2,600. The fish began hatching February 24, and all were out by the middle of March.

Shortly after these fish hatched an accident occurred by which 18,000 of them perished. On the night of March 21 a flooding rain-storm washed into the feeding reservoir, and thence into the tanks supplying the hatching boxes, a sufficient quantity of moss, leaves, and *débris* generally to almost wholly clog the screens, diverting to the overflow or waste channel the water that should have passed through the trays on which the fish were still retained. The oldest fry fared much worse than those more recently hatched, and especially those in boxes at the foot of the row, the limited amount of fresh water still running having become de-oxygenated before reaching them. In the head boxes, and also in an adjoining row of boxes containing fry of brook trout (of about same age, but much smaller), the loss was merely nominal. In a third row containing the Schoodic salmon, just hatched, there was no loss whatever.

I had felt that everything was secure and free from danger of accidents—that every precaution for the safety of the fish had been observed; but since meeting with so serious a loss from a source wholly unanticipated, I can but feel that the only safeguard against accidents or insecurity lies in never leaving the fish alone, and shall, therefore, in the future, employ a nightwatch so long as fish in any considerable numbers remain in the hatchery.

Appended is a statement of distribution, &c.:

Number eggs received from California		75,000
Loss on eggs during incubation		3,500
Number fish hatched		71,500
Loss by accident, as noted	18,000	
Loss of fry to date (June 30) in nursery tanks	3,500	
Fry on hand in nursery tanks	10,000	
April 28—Deposited at Beitner Station, Grand Traverse County, Michigan, in Boardman River, tributary to Grand Traverse Bay	3,000	
May 2—Delivered to A. C. Lanier, of Madison, Ind	3,000	
May 7—Deposited by George N. Matheson, of Sarnia, Ontario, in small stream in Western Ontario, tributary to Lake Saint Clair	3,000	

May 16—Deposited by James R. Bull, of Saint Louis, Mo., in Island Lake, Monroe County, Illinois	3,000	
May 29—Deposited in Oakland County, Michigan, in Deer Lake, through which flows the Clinton River, tributary to Lake Saint Clair	10,000	
June 1—Deposited in Oakland County, Michigan, in Straits Lake, through which flows the Huron River, tributary to Detroit River	10,000	
June 3—Deposited in Wayne County, Michigan, in northeastern branch of river Rouge	8,000	
		71,500

From eight adult California trout, five of which are females, all brought from California four years ago and since confined in the ponds here, we took 5,150 eggs between the 13th and the 29th of March, which hatched on an average in 38 days. The loss on eggs was 850; and on April 26, 1,200 eggs were shipped to F. Mather for reshipment to Herr von Behr, Germany. The 3,100 fish that hatched were deposited May 16, by James R. Bull, of Saint Louis, Mo., in Murdoch Lake, Monroe County, Illinois.

Next spring we expect to take at least 100,000 eggs from the stock of California trout now on hand, that will then make their début as spawners. About half of these fish are the progeny of the eight adult fish above mentioned. They were two years old last spring, an age at which a majority of our brook trout have always spawned, although a portion of them, perhaps one-fifth, do not until three years old. We had therefore anticipated getting a nice supply of eggs from them, but failed to find a single mature spawner. Several females were opened at various times through the winter, with the result of finding only minute ova to mature a year later; still, we felt confident that a few of them at least would spawn, thinking we had missed the right ones; all the more so, too, from the fact that ripe males were numerous even three or four months in advance of the regular spawning season; in fact, the eggs taken from the adult California trout were mostly impregnated with milt from the two-year-olds. Failure to obtain a single egg from these fish, of which there are at least four or five hundred females, leaves little room to doubt the conclusion that the *iridea* seldom, if ever, spawn when two years old, at least where they are confined in ponds from infancy.

HATCHING AND DISTRIBUTION OF EGGS OF SCHOODIC SALMON.

On the 28th of February, Mr. Charles G. Atkins shipped from Grand Lake Stream, Maine, for the Northville hatchery, a case of 46,500 eggs of Schoodic or land-locked salmon. They arrived March 4, and opened up in excellent condition, only 45 dead eggs being observed on unpacking. Previous to hatching, 1,065 more were picked away, showing a total loss of 1,110 eggs after arrival.

The fish began to come out March 16, rather slowly for two or three days, the water being down to 43½° on an average; but on the 19th the water ran up to 54° at noon, and the fish then came out with a rush, scarcely an egg remaining the day following. Quite a number of monstrosities and imperfect fish were observed, outside of which, however, they looked unexceptionally fine. They were also exceedingly active and strong in view of the great disproportion between their large, kidney-shaped sacs and light, slender bodies.

Soon after they began hatching, the novel spectacle of occasionally seeing the body of a fish on one side of the tray, with its sac underneath, was presented—due to the wonderful mobility of the sac, which sometimes permitted the downward current to draw it through the mesh of the tray, although four or five times larger than the aperture through which it had passed; after passing through it would soon assume its natural shape, protruding like an immense hernia, from which position the fish would be quite unable to extricate themselves. By inverting the tray and agitating in water, the soft, ductile pouch would soon pass back, releasing the fish unharmed. To overcome this difficulty, which at one time threatened to become quite annoying, the hatching boxes were reversed, so that the water passed upward through the trays instead of down, as before.

Below is the statement of distribution:

Number of salmon hatched		45,390
Imperfect and dead fish picked from hatching boxes and nursery tanks	4,540	
Fish now on hand in nursery tanks	2,850	
April 27—Deposited in Long Lake, Mecosta County, Michigan	6,000	
April 28—Deposited in Higgins Lake, Roscommon County, Michigan	3,000	
April 27—Deposited in Chippewa Lake, Lake County, Michigan	6,000	
May 1—Deposited by N. A. Osgood in Goguac Lake, near Battle Creek, Michigan, (fish shipped by express)	3,000	
May 3—Deposited at Piqua, Ohio, in water-works reservoir, containing 150 acres	6,000	
May 10—Deposited in Union Lake, township of Pontiac, Oakland County, Michigan	8,000	
May 15—Shipped per express from Toledo, Ohio, to S. E. Williams, La Porte, Ind	3,000	
May 15—Shipped per express from B. & O. junction with the Wabash, to T. B. Wightman, Cedar Beach, Ind	3,000	
		45,390

The fish were all planted in excellent condition, with the exception of the last two lots. Mr. Wightman reported that the fish sent him were

all dead on arrival, and Mr. Williams that nearly all were dead when received, the remainder being deposited in a lake near La Porte.

After successfully shipping 3,000 by express to Battle Creek, using in transit three to four hours, I was not a little surprised at the non-success of the other shipments; all the more so from the fact that those to Battle Creek were sent in one 10-gallon can without the loss of a single fish, whereas with each of the other lots two 10-gallon cans were used, which would more than offset the difference in time occupied in transit to their respective destinations. In all three consignments the water was reduced to icy coldness before starting.

The results attending these shipments, which were, to a certain extent, in the nature of an experiment, justify the conclusion that with the transportation of live fish success in one instance fails to establish a basis for calculations in other instances, where even the conditions and circumstances are, to all intents and purposes, alike; and that the chances of failure are reduced to the minimum only when the fish are under the constant surveillance of an experienced messenger.

DISTRIBUTION OF EGGS OF LAKE TROUT. (*Cristivomer namaycush.*)

When Mr. Wires started for Alpena in the latter part of October to look after the collection of whitefish eggs at that point, instructions were given him to obtain, if possible, a few eggs of lake trout if he arrived too early for the whitefish work. As the few whitefish then being captured in the inshore fisheries showed little indications of spawning, Mr. Wires, on the last day of October, put out about forty miles to the gill-net fisheries, where he found the lake trout nearly all spent, but succeeded in getting 57,000 eggs. These were shipped by boat to Bay City, whence they were met by special messenger and delivered to the Northville hatchery, November 2.

The loss of eggs while in the hatchery was 3,600; December 10, 20,000 were consigned to Mr. F. Mather for reshipment to Herr von Behr, Germany; and on January 3, 30,000 were forwarded to Commissioner Shaw of Iowa, who reported that they arrived in prime condition January 6 and commenced hatching the day following, the total loss on eggs and fish being less than 5 per cent. The eggs were now well along in advancement; in fact a few hatched the same day that the Iowa shipment was made; nevertheless a package of 2,000 was shipped to Newark January 7 to be transmitted by Mr. Mather to France, if their condition when received by him would warrant it; but despite their being reduced to a temperature of 31° before leaving the hatchery, a few hatched on their way to Newark, and Mr. Mather, therefore, hatched the remainder, the fry being subsequently released in Culver's Lake, Sussex County, New Jersey.

The stock of embryos and alevins was now reduced to 1,400; and these, after the hatching and sac-consuming process was completed, were

placed in one of the largest nursery tanks, where they still remain. Less than two dozen have died since hatching; they now average 3 inches in length, and are doing remarkably well, having learned to devour the liver and kidney "hash" given them as greedily as the brook trout in the ponds.

SUMMARY OF THE WORK AND ITS COST.

Number of eggs of whitefish shipped	2,032,000
Number of fry of whitefish planted	17,750,000
Number of eggs of brook trout shipped	50,000
Number of fry of brook trout planted	58,000
Number of fry of brook trout on hand	10,000
Number of eggs of California trout shipped	1,200
Number of fry of California trout planted	43,100
Number of fry of California trout on hand	10,000
Number of fry of Schoodic salmon planted	32,000
Number of fry of Schoodic salmon on hand	2,850
Number of eggs of lake trout shipped	52,000
Number of fry of lake trout on hand	1,400
Number of carp shipped	1,500
Approximate cost of the work, including the construction of seven new trout-ponds with their raceways, twelve new nursery tanks, and the cost of fish food for the year	$5,000

Temperature of Lake Erie from March 20 to June 1, 1882, taken daily at 12 m., near North Bass Island, by Chas. Hasford.

Date.	Temperature.	Date.	Temperature.	Date.	Temperature.	Date.	Temperature.
	°F.		°F.		°F.		°F.
March 20	38	April 8	45	April 26	46	May 14	49
21	37	9	44	27	48	15	48
22	36	10	42	28	49	16	49
23	38	11	41	29	40	17	51
24	37	12	42	30	49	18	53
25	37	13	42	May 1	49	19	54
26	38	14	42	2	48	20	54
27	40	15	43	3	50	21	54
28	39	16	44	4	50	22	54
29	41	17	47	5	49	23	53
30	40	18	49	6	48	24	54
31	39	19	47	7	48	25	55
April 1	40	20	46	8	49	26	56
2	42	21	47	9	49	27	56
3	42	22	46	10	50	28	55
4	44	23	46	11	49	29	56
5	43	24	46	12	49	30	58
6	44	25	47	13	49	31	58
7	45						

UNITED STATES COMMISSION OF FISH AND FISHERIES.

Record of temperature observations made at Northville, Mich., from November 15, 1881, to April 15, 1882.

Date.		Temperature at—						Wind at—						Condition of—		
		8 a.m.		1 p.m.		5 p.m.		8 a.m.		1 p.m.		5 p.m.		Sky.		
Day of week.	Day of month.	Air.	Water.	Air.	Water.	Air.	Water.	Direction.	Intensity.	Direction.	Intensity.	Direction.	Intensity.	8 a.m.	1 p.m.	5 p.m.
Tuesday	Nov. 15	27	38	36	40	32	42	West.	Brisk.	West.	Light.	West.	Light.	Cloudy.	Cloudy.	Clear.
Wednesday	16	34	42	46	43	42	45	East.	Light.	South.	Light.	South.	Light.	Cloudy.	Clear.	Cloudy.
Thursday	17	48	44	54	46	54	48	South.	Light.	SW.	Brisk.	SW.	Brisk.	Cloudy.	Cloudy.	Cloudy.
Friday	18	38	48	40	44	40	46	North.	Light.	East.	Mild.	East.	Light.	Cloudy.	Cloudy.	Snowing.
Saturday	19	32	41	34	42	30	42	West.	Light.	West.	Light.	West.	High.	Cloudy.	Cloudy.	Cloudy.
Sunday	20	24	37	28	39	26	42	West.	Light.	West.	Light.	West.	Light.	Cloudy.	Clear.	Clear.
Monday	21	33	39	39	41	36	42	SW.	Light.	SW.	Brisk.	SW.	Light.	Cloudy.	Cloudy.	Cloudy.
Tuesday	22	22	39	36	41	26	41	East.	Light.	SE.	Calm.	NW.	Calm.	Cloudy.	Cloudy.	Clear.
Wednesday	23	27	39	40	42	30	43	SW.	Light.	SW.	Light.	West.	Light.	Cloudy.	Clear.	Cloudy.
Thursday	24	20	35	24	36	25	36	West.	Light.	SW.	Brisk.	West.	Brisk.	Cloudy.	Cloudy.	Cloudy.
Friday	25	18	33	28	35	26	35	SW.	Light.	South.	Brisk.	SE.	Brisk.	Clear.	Cloudy.	Cloudy.
Saturday	26	34	37	36	39	35	40	SW.	Brisk.	West.	Brisk.	SW.	Brisk.	Cloudy.	Clear.	Cloudy.
Sunday	27	34	39	42	40	35	41	SW.	Brisk.	SW.	Light.	SW.	Light.	Cloudy.	Cloudy.	Cloudy.
Monday	28	31	40	41	43	36	44	SW.	Light.	South.	Light.	South.	Light.	Cloudy.	Clear.	Clear.
Tuesday	29	38	42	48	44	50	46	West.	Light.	SW.	Light.	SW.	Light.	Clear.	Clear.	Clear.
Wednesday	30	44	46	57	48	44	48	SW.	Light.	SW.	Light.	SW.	Light.	Cloudy.	Clear.	Cloudy.
Thursday	Dec. 1	36	46	37	48	36	45	SW.	Light.	West.	Brisk.	West.	Brisk.	Cloudy.	Cloudy.	Cloudy.
Friday	2	32	43	38	44	36	44	SW.	Fresh.	South.	Light.	South.	Light.	Cloudy.	Cloudy.	Cloudy.
Saturday	3	35	43	42	44	38	45	NW.	Light.	West.	Light.	SW.	Light.	Cloudy.	Cloudy.	Cloudy.
Sunday	4	34	43	40	43	39	46	SW.	Light.	SW.	Light.	SW.	Light.	Cloudy.	Cloudy.	Cloudy.
Monday	5	32	43	39	43	32	42	West.	Light.	NW.	Light.	SW.	Light.	Cloudy.	Cloudy.	Cloudy.
Tuesday	6	36	41	40	42	42	43	SW.	Light.	South.	Light.	SE.	Light.	Cloudy.	Cloudy.	Cloudy.
Wednesday	7	32	40	32	41	28	40	West.	Strong.	West.	Strong.	West.	Light.	Clear.	Clear.	Clear.
Thursday	8	26	39	36	39	32	39	SE.	Light.	SW.	Light.	SE.	Light.	Cloudy.	Cloudy.	Cloudy.
Friday	9	29	39	32	40	29	40	West.	Light.	West.	Light.	West.	Light.	Clear.	Clear.	Clear.
Saturday	10	10	36	22	38	26	39	West.	Light.	West.	Light.	NW.	Light.	Clear.	Clear.	Clear.
Sunday	11	24	37	32	38	31	38	SW.	Light.	SE.	Light.	SE.	Light.	Cloudy.	Cloudy.	Cloudy.
Monday	12	36	41	42	41	43	42	South.	Light.	SW.	Light.	SE.	Light.	Cloudy.	Cloudy.	Cloudy.
Tuesday	13	50	45	56	47	53	48	South.	Light.	SW.	Fresh.	SW.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Wednesday	14	36	44	32	44	28	43	NW.	Fresh.	NW.	Fresh.	West.	Light.	Cloudy.	Cloudy.	Clear.
Thursday	15	18	39	28	40	24	41	West.	Light.	SW.	Light.	West.	Light.	Clear.	Clear.	Clear.
Friday	16	24	38	40	39	37	41	West.	Light.	South.	Light.	South.	Fresh.	Clear.	Cloudy.	Cloudy.
Saturday	17	30	39	48	41	40	43	South.	Light.	South.	Light.	South.	Light.	Clear.	Clear.	Cloudy.

Record of temperature observations made at Northville, Mich., &c.—Continued.

DATE.			TEMPERATURE AT—						WIND AT—						CONDITION OF—		
			8 a.m.		1 p.m.		5 p.m.		8 a.m.		1 p.m.		5 p.m.		Sky.		
Day of week.	Day of month.		Air.	Water.	Air.	Water.	Air.	Water.	Direction.	Intensity.	Direction.	Intensity.	Direction.	Intensity.	8 a. m.	1 p. m.	5 p. m.
Sunday	Dec.	18	32	41	44	42	32	41	SW.	Light.	NW.	Light.	NW.	Light.	Clear.	Clear.	Clear.
Monday		19	28	41	46	43	40	45	West.	Light.	SW.	Light.	South.	Light.	Clear.	Clear.	Cloudy.
Tuesday		20	38	44	44	45	40	44	SE.	Light.	NW.	Light.	NE.	Light.	Cloudy.	Cloudy.	Cloudy.
Wednesday		21	36	44	40	43	41	46	NE.	Light.	East.	Fresh.	East.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Thursday		22	42	47	46	48	40	48	NW.	Light.	NW.	Light.	NW.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Friday		23	38	40	32	41	28	40	North.	Strong.	North.	Strong.	NW.	Light.	Clear.	Clear.	Clear.
Saturday		24	20	39	32	40	32	42	South.	Light.	South.	Light.	SW.	Light.	Clear.	Clear.	Clear.
Sunday		25	28	40	40	41	36	44	West.	Light.	SW.	Light.	SW.	Light.	Clear.	Cloudy.	Cloudy.
Monday		26	35	44	44	45	40	48	SW.	Light.	SW.	Light.	NW.	Light.	Cloudy.	Cloudy.	Cloudy.
Tuesday		27	32	42	44	43	40	44	NE.	Light.	NE.	Light.	NW.	Calm.	Clear.	Cloudy.	Cloudy.
Wednesday		28	42	45	48	46	46	48	SW.	Light.	SW.	Light.	SW.	Calm.	Cloudy.	Cloudy.	Cloudy.
Thursday		29	32	44	42	46	38	46	SW.	Calm.	SW.	Light.	West.	Calm.	Clear.	Clear.	Clear.
Friday		30	22	41	26	42	22	39	SW.	Calm.	SW.	Light.	SW.	Fresh.	Clear.	Cloudy.	Cloudy.
Saturday		31	21	37	26	38	22	38	SW.	Fresh.	West.	Light.	West.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Sunday	Jan.	1	16	36	20	36	19	36	NW.	Fresh.	West.	Light.	SW.	Light.	Cloudy.	Cloudy.	Cloudy.
Monday		2	5	36	22	38	26	38	SW.	Light.	SW.	Light.	SW.	Light.	Clear.	Clear.	Cloudy.
Tuesday		3	22	38	24	38	16	38	SW.	Fresh.	NE.	Fresh.	North.	Light.	Cloudy.	Cloudy.	Cloudy.
Wednesday		4	16	36	20	37	17	36	NE.	Light.	East.	Fresh.	East.	Light.	Cloudy.	Cloudy.	Cloudy.
Thursday		5	13	35	26	37	28	37	NE.	Light.	NE.	Light.	NE.	Light.	Cloudy.	Cloudy.	Cloudy.
Friday		6	28	38	30	38	33	40	North.	Light.	West.	Fresh.	West.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Saturday		7	33	40	38	41	36	41	North.	Light.	East.	Light.	East.	Light.	Cloudy.	Cloudy.	Cloudy.
Sunday		8	44	43	52	46	41	41	West.	Calm.	SW.	Fresh.	SW.	Strong.	Cloudy.	Cloudy.	Cloudy.
Monday		9	29	41	32	40	32	41	West.	Fresh.	SW.	Fresh.	West.	Light.	Cloudy.	Cloudy.	Cloudy.
Tuesday		10	26	39	34	40	33	39	West.	Calm.	East.	Light.	East.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Wednesday		11	30	39	40	41	36	41	SW.	Light.	SW.	Light.	SW.	Light.	Cloudy.	Cloudy.	Cloudy.
Thursday		12	10	38	42	40	30	40	SW.	Calm.	South.	Light.	SE.	Light.	Clear.	Cloudy.	Cloudy.
Friday		13	24	40	38	42	38	44	South.	Light.	SW.	Light.	SW.	Light.	Cloudy.	Cloudy.	Cloudy.
Saturday		14	20	38	22	38	22	38	SW.	Fresh.	SW.	Light.	SW.	Light.	Cloudy.	Clear.	Clear.
Sunday		15	28	38	40	39	36	42	SW.	Calm.	SW.	Light.	SW.	Light.	Cloudy.	Cloudy.	Cloudy.
Monday		16	28	40	26	39	20	39	West.	Calm.	West.	Light.	West.	Light.	Cloudy.	Cloudy.	Cloudy.
Tuesday		17	6	35	17	38	10	38	West.	Calm.	West.	Light.	West.	Calm.	Clear.	Clear.	Clear.
Wednesday		18	4	36	20	38	22	38	West.	Calm.	SW.	Light.	SW.	Light.	Cloudy.	Cloudy.	Cloudy.
Thursday		19	27	38	28	40	23	41	West.	Calm.	SW.	Calm.	SW.	Calm.	Clear.	Clear.	Clear.
Friday		20	24	38	34	40	33	41	West.	Calm.	SW.	Light.	SW.	Light.	Clear.	Clear.	Cloudy.
Saturday		21	34	31	37	44	34	44	SW.	Light.	SW.	Light.	SW.	Light.	Cloudy.	Cloudy.	Cloudy.

Sunday		22	15	35	16	35	10	34	SW.	Strong.	SW.	Strong.	SW.	Strong.	Cloudy.	Cloudy.	Cloudy.
Monday		23	5	34	18	36	12	37	West.	Light.	West.	Light.	NW.	Light.	Clear.	Clear.	Cloudy.
Tuesday		24	2	35	16	36	12	37	SW.	Calm.	South.	Fresh.	SW.	Light.	Clear,	Clear.	Cloudy.
Wednesday		25	22	36	34	37	34	39	South.	Calm.	South.	Light.	South.	Light.	Cloudy.	Cloudy.	Cloudy.
Thursday		26	36	41	44	42	42	44	South.	Calm.	South.	Calm.	SW.	Light.	Cloudy.	Cloudy.	Cloudy.
Friday		27	30	38	34	40	33	44	SW.	Light.	SW.	Light.	SE.	Light.	Clear.	Clear.	Clear.
Saturday		28	30	40	48	42	30	41	SW.	Calm.	SW.	Fresh.	West.	Strong.	Cloudy.	Cloudy.	Clear.
Sunday		29	11	32	20	35	18	36	NW.	Fresh.	NW.	Fresh.	SW.	Strong.	Clear.	Clear.	Clear.
Monday		30	13	34	30	37	28	38	SW.	Light.	SW.	Light.	SW.	Light.	Clear.	Clear.	Cloudy.
Tuesday		31	22	38	34	40	28	42	NW.	Light.	NW.	Calm.	NW.	Calm.	Cloudy.	Cloudy.	Cloudy.
Wednesday	Feb.	1	30	40	40	42	35	42	SW.	Light.	SW.	Fresh.	SW.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Thursday		2	24	40	40	42	40	44	SW.	Light.	SW.	Light.	South.	Light.	Clear.	Clear.	Clear.
Friday		3	20	40	30	41	28	44	West.	Calm.	NE.	Light.	NE.	Calm.	Clear.	Clear.	Clear.
Saturday		4	26	40	38	44	36	43	West.	Calm.	West.	Light.	West.	Fresh.	Clear.	Clear.	Cloudy.
Sunday		5	20	40	40	43	38	44	SW.	Calm.	SW.	Light.	SW.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Monday		6	28	42	37	44	36	44	SW.	Calm.	South.	Calm,	SE.	Light.	Clear.	Clear.	Cloudy.
Tuesday		7	38	42	48	44	46	44	SW.	Calm.	SW.	Fresh.	SW.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Wednesday		8	29	40	36	44	32	46	SW.	Calm.	SW.	Light.	SW.	Calm.	Clear.	Clear.	Clear.
Thursday		9	20	41	40	43	36	46	West.	Calm.	West.	Calm.	West.	Calm.	Clear.	Clear.	Cloudy.
Friday		10	30	40	36	42	32	41	West.	Light.	West.	Light.	SW.	Light.	Clear.	Clear.	Cloudy.
Saturday		11	32	41	42	42	40	44	SW.	Calm.	SW.	Calm.	SW.	Calm.	Clear.	Cloudy.	Cloudy.
Sunday		12	44	46	54	48	52	49	SW.	Calm.	SW.	Fresh.	South.	Fresh.	Cloudy.	Cloudy.	Clear.
Monday		13	44	49	42	48	40	49	SW.	Fresh.	SW.	Strong.	SW.	Fresh.	Cloudy.	Clear.	Clear.
Tuesday		14	26	43	42	46	40	48	SW.	Calm.	SW.	Fresh,	SW.	Light.	Clear.	Clear.	Cloudy.
Wednesday		15	32	42	48	46	42	50	South.	Calm.	SW.	Fresh.	South.	Light.	Clear.	Clear.	Clear.
Thursday		16	34	45	46	46	50	48	SW.	Fresh.	SW.	Calm.	SW.	Calm.	Cloudy.	Cloudy.	Cloudy.
Friday		17	28	43	26	42	47	42	SW.	Calm.	NW.	Fresh.	North.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Saturday		18	22	38	32	40	22	42	NE.	Calm.	NE.	Fresh.	NE.	Fresh.	Clear.	Clear.	Clear.
Sunday		19	36	42	46	44	30	44	NW.	Calm.	West.	Light.	West.	Light.	Cloudy.	Cloudy.	Cloudy.
Monday		20	30	42	36	42	40	42	North.	Fresh.	NE.	Light.	NE.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Tuesday		21	32	41	26	39	30	38	SW.	Fresh.	SW.	Strong.	SW.	Strong.	Cloudy.	Cloudy.	Cloudy.
Wednesday		22	20	35	22	38	26	37	SW.	Fresh.	SW.	Strong.	SW.	Strong.	Clear.	Cloudy.	Cloudy.
Thursday		23	14	36	30	39	16	40	SW.	Light.	West.	Light.	SW.	Light.	Clear.	Cloudy.	Cloudy.
Friday		24	18	38	29	41	22	45	NW.	Light.	NW.	Light.	NE.	Light.	Clear.	Clear.	Clear.
Saturday		25	14	39	30	40	20	39	NW.	Light.	NW.	Light.	NW.	Light.	Clear.	Clear.	Clear.
Sunday		26	30	42	42	45	28	44	SW.	Light.	SW.	Light.	SW.	Light.	Clear.	Cloudy.	Clear.
Monday		27	38	45	48	46	43	46	SW.	Light.	SW.	Light.	SW.	Light.	Clear.	Clear.	Clear.
Tuesday		28	43	46	44	46	42	47	South.	Light.	SW.	Light.	SE.	Light.	Cloudy.	Cloudy.	Cloudy.
Wednesday	Mar.	1	48	48	55	52	46	50	South.	Light.	South.	Light.	South.	Light.	Clear.	Clear.	Clear.
Thursday		2	46	48	62	55	44	53	South.	Light.	South.	Light.	South.	Light.	Clear.	Clear.	Clear.
Friday		3	44	48	48	52	47	51	West.	Fresh.	West.	Fresh.	West.	Light.	Clear.	Clear.	Clear.
Saturday		4	33	45	46	47	44	47	NE.	Fresh.	East.	Fresh.	East.	Light.	Cloudy.	Cloudy.	Cloudy.
Sunday		5	48	48	58	54	52	52	SE.	Light.	SE.	Light.	South.	Light.	Cloudy.	Clear.	Clear.
Monday		6	36	45	52	50	50	49	SW.	Light.	SE.	Light.	SE.	Light.	Cloudy.	Clear.	Clear.
Tuesday		7	38	46	56	53	51	49½	SE.	Fresh.	SE.	Fresh.	SE.	Fresh.	Cloudy.	Clear.	Clear.
Wednesday		8	41	46	58	54	50	49	SE.	Fresh.	SE.	Fresh.	SE.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Thursday		9	34	42	38	43	36	44	NE.	Light.	NE.	Light.	NE.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Friday		10	30	42	34	42	31	42	NW.	Light.	NW.	Fresh.	NW.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Saturday		11	30	42	36	44	31	45	West.	Fresh.	NW.	Fresh.	NW.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Sunday		12	33	44	36	46	31	45	NE.	Light.	NE.	Light.	NE.	Light.	Cloudy.	Clear.	Cloudy.
Monday		13	28	42	32	45	30	45	NE.	Fresh.	NE.	Fresh.	NE.	Light.	Clear.	Clear.	Cloudy.
Tuesday		14	28	42	38	45	40	48	West.	Light.	NW.	Light.	NW.	Light.	Clear.	Clear.	Cloudy.

Report of temperature observations made at Northville, Mich., &c.—Continued.

DATE.		TEMPERATURE AT—						WIND AT—						CONDITION OF—		
		8 a. m.		1 p. m.		5 p. m.		8 a. m.		1 p. m.		5 p. m.		Sky.		
Day of week.	Day of month.	Air.	Water.	Air.	Water.	Air.	Water.	Direction.	Intensity.	Direction.	Intensity.	Direction.	Intensity.	8 a. m.	1 p. m.	5 p. m.
Wednesday	Mar. 15	30	41	34	44	32	43	SE.	Light.	SE.	Light.	SE.	Light.	Cloudy.	Cloudy.	Cloudy.
Thursday	16	33	42	40	44	34	46	South.	Light.	South.	Light.	South.	Light.	Cloudy.	Cloudy.	Clear.
Friday	17	28	40	44	45	30	41	East.	Light.	East.	Light.	East.	Fresh.	Clear.	Cloudy.	Cloudy.
Saturday	18	36	43	44	45	46	46	East.	Light.	SE.	Light.	SE.	Light.	Cloudy.	Cloudy.	Cloudy.
Sunday	19	34	43	52	54	50	52	NW.	Light.	NW.	Light.	NW.	Light.	Clear.	Clear.	Cloudy.
Monday	20	40	47	48	49	40	48	NE.	Light.	NE.	Light.	NE.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Tuesday	21	34	44	32	44	26	43	West.	Light.	West.	High.	West.	High.	Cloudy.	Cloudy.	Cloudy.
Wednesday	22	24	41	30	42	30	42	NW.	Fresh.	NW.	Fresh.	NW.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Thursday	23	30	41	44	47	48	48	SE.	Light.	SE.	Fresh.	West.	Light.	Clear.	Clear.	Cloudy.
Friday	24	21	40	30	44	26	44	NW.	Light.	NW.	Fresh.	NW.	Light.	Clear.	Clear.	Clear.
Saturday	25	26	41	35	43	30	42	NW.	Light.	SE.	Fresh.	SE.	Light.	Clear.	Cloudy.	Cloudy.
Sunday	26	38	44	54	50	53	52	SE.	Light.	SE.	Fresh.	SE.	Light.	Cloudy.	Cloudy.	Cloudy.
Monday	27	38	50	48	50	36	48	SW.	Light.	West.	Fresh.	West.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Tuesday	28	28	42	49	50	47	49	NE.	Light.	NE.	Light.	NE.	Light.	Clear.	Clear.	Clear.
Wednesday	29	36	42	56	44	53	51	SE.	Light.	SE.	Light.	SE.	Light.	Clear.	Clear.	Clear.
Thursday	30	35	42	42	48	40	47	SW.	Fresh.	SW.	Fresh.	West.	Light.	Clear.	Clear.	Clear.
Friday	31	34	42	44	46	38	46	SW.	Fresh.	SW.	Fresh.	SW.	Light.	Cloudy.	Cloudy.	Cloudy.
Saturday	Apr. 1	40	45	62	54	63	56	SW.	Light.	SW.	Light.	SW.	Light.	Clear.	Clear.	Clear.
Sunday	2	60	50	70	58	62	55	SW.	Light.	SW.	Light.	NE.	Light.	Clear.	Clear.	Clear.
Monday	3	38	48	68	56	64	54	SE.	Light.	South.	Light.	South.	Light.	Clear.	Clear.	Clear.
Tuesday	4	50	50	66	55	60	53	South.	Light.	SW.	Fresh.	SW.	Fresh.	Cloudy.	Cloudy.	Cloudy.
Wednesday	5	48	50	67	56	58	54	West.	Fresh.	West.	Fresh.	West.	Fresh.	Clear.	Cloudy.	Cloudy.
Thursday	6	52	51	58	53	59	51	NW.	Fresh.	NW.	Fresh.	NW.	Fresh.	Clear.	Clear	Clear.
Friday	7	51	49	57	51	56	50	West.	Fresh.	West.	Fresh.	West.	Fresh.	Clear.	Clear	Clear.
Saturday	8	42	48	52	50	50	50	NE.	Light.	NE.	Light.	NE.	Light.	Cloudy.	Cloudy.	Cloudy.
Sunday	9	51	49	44	48	44	48	East.	Fresh.	East.	Light.	East.	Light.	Cloudy.	Cloudy.	Cloudy.
Monday	10	42	48	30	42	24	41	East.	Fresh.	East.	Fresh.	East.	Light.	Cloudy.	Cloudy.	Cloudy.
Tuesday	11	40	47	28	41	29	42	NW.	Light.	NW.	Fresh.	NW.	Fresh.	Clear.	Cloudy.	Clear.
Wednesday	12	26	41	40	44	38	44	NW.	Light.	North.	Fresh.	North.	Light.	Cloudy.	Clear.	Clear.
Thursday	13	22	40	42	45	46	47	NW.	Light.	North.	Light.	NE.	Light.	Cloudy.	Cloudy.	Cloudy.
Friday	14	30	40	40	44	45	45	NE.	Light.	NE.	Light.	NE.	Light.	Cloudy.	Cloudy.	Cloudy.
Saturday	15	36	44	48	50	43	49	North.	Light.	NE.	Light.	NE.	Light.	Clear.	Clear.	Cloudy.

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