
This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

Google™ books

<http://books.google.com>



SH

11

P4

1868,

1870-71

Lot 4.00

2 pl.

- 125 of all

COMMONWEALTH OF PENNSYLVANIA.

REPORT

OF THE

Commissioner for the Restoration

OF THE

Fisheries of the Susquehanna,

FOR THE YEAR 1868.



HARRISBURG:

B. SINGERLY, STATE PRINTER.

1869.

REPORT

OF

COL. JAMES WORRALL,

IN RELATION TO THE

Passage of Fish in the Susquehanna River,

MADE TO THE

GOVERNOR IN PURSUANCE OF LAW,

JANUARY 18, 1869.



HARRISBURG:

B. SINGERLY, STATE PRINTER.

1869.

@
SH11
P4
1868,
1870,71

a) 2 2 2 2 6

REPORT.

HARRISBURG, *January 18, 1869.*

To his Excellency JOHN W. GEARY,
Governor of Pennsylvania:

MY DEAR SIR:—By your kind permission I have been allowed to delay my annual report until this time, there being some information which I could not obtain at an earlier period.

We have still reason to congratulate ourselves on the success of our endeavors to re-introduce migratory fish into the waters of the Susquehanna. There was a respectable catch above the Columbia dam last spring, notwithstanding that the season was unpropitious along the whole Atlantic coast—and even the sea fishing failed to such an extent as to have resulted in a loss to those engaged in it. The snow water in the Susquehanna remained last year to a very late day—late in May, and heavy freshets followed; indeed the water was high during the whole season, a circumstance always adverse to successful fishing.

The catch in the fifty miles could not have exceeded five thousand against fifteen to eighteen thousand, the estimated catch of the year before. At fisheries, however, but a short distance above Philadelphia, on the Delaware, where there are no dams, the hauls were equally unsuccessful, and on the Potomac the seines were early put away as being not worth the labor of working. The cod fisheries of New Foundland were carried on at a loss during the same season, and the shore fisheries of the New England States tell the same story.

It is difficult to account for this general falling off; nay, it is impossible to more than remotely suggest a cause. The past season, however, has been a season of earthquakes and volcanic eruptions. Most of the vent holes of the internal fires of the earth have been more or less active. Our side of this continent has not indeed been appreciably disturbed. But might not the ocean, which is a connected body, have felt these mysterious influences? Be the cause what it may, the catch has been very far below the average.

This, however, is not the mystery which interests us. The wonder is that we catch any shad at all in our upper waters.

In the performance of my duty, during the past season, I visited the lower Susquehanna, passing along its bank all the way from Columbia to Havre de Grace, and it is indeed surprising that any of the shad should escape up the river into Pennsylvania.

The Susquehanna enters Chesapeake bay through a regularly formed estuary, about four or five miles long and about a mile in width.

The Susquehanna is distinguished on this continent of beautiful rivers as one of the most beautiful among them. The river, above Columbia, is well known. The railroads have opened its valley to the gaze of multitudes of admiring travelers. From Columbia to St. Mary's, in Elk county, *via* the West Branch—St. Mary's, where it is a mere "bubbling runnel"—the line of river is known and admired by all who pass along the Northern Central and Philadelphia and Erie railways.

From Duncan's Island to Hollidaysburg, nay, to Kittanning Point, who does not know the "Blue Juniata?" From Sunbury to Binghampton and Elmira, in the State of New York, the North Branch and its branches meander, and within this reach occurs—

"On Susquehanna's side fair Wyoming."

But beautiful and romantic and attractive as this splendid water course of ours is at all other points, there is no part of it more beautiful, more romantic or more attractive than that almost unknown portion of the valley extending from Columbia to Havre de Grace, and nothing becomes the river in its whole range better than the graceful manner in which it enters Chesapeake bay.

The estuary I speak of is four or five miles long and pulsates with the tide. It is bounded on the shores by softly rounded hills, rising perhaps two hundred feet from the water, between two of which it enters the bay, putting one in mind of the *Gros Cape* and the *Point aux Chenes* of Lake Superior, where the St. Mary's strait leaves that vast expanse of water. This beautiful estuary is probably one of the most attractive rendezvous for migratory fish that exists along our whole coast. It is the mouth of a river whose main stem and branches give a coast line of very considerably over a thousand miles.

Let any person consider for a moment its extent. Measure from Bedford Springs to the mouth of the Raystown Branch of the Juniata below Huntington. From Hollidaysburg to Duncannon, the mouth of the main Juniata. From Bennett's Branch, in Clinton county, to Sunbury. From, say the New York State line, on the North Branch, to the mouth of the river at Havre de Grace. These are all reaches of the stream independent of each other. Now, let these distances be summed up, and it will scarcely be necessary to measure both banks to produce a thousand miles of coast. The thread of the streams is in length about three-fourths of that distance.

There is no finer water in the world than what is delivered into the Chesapeake bay by the Susquehanna, and why then should not its estuary be a favorite place of rendezvous for these migratory fish, seeking pure water flowing over gravelly beds for their spawning ground?

But leaving the estuary let us follow the stream as it comes from the up country.

Immediately after leaving Port Deposit, the Susquehanna is found to be interrupted in its flow by a belt of primitive and igneous rocks, which continues until you reach Columbia, a distance of some forty miles. These rocks are all islands in low water, many of them being covered when the water is high. They vary in size from that of a bushel basket to great humps, hundreds of feet in height, and many acres in extent, and present the most varied scenery conceivable.

The "thousand islands" of the St. Lawrence, where that river passes over a similar geological formation, make a panorama apparently infinite in its variety, and one would suppose incomparable with any other river scenery. But here on the Susquehanna the same causes have produced like effects, and instead of a thousand islands, there must be several thousands of them, of every conceivable size and shape, between the two magnitudes I have mentioned. In these forty miles there is a fall of two hundred feet, and this being somewhat unequally distributed, the currents vary in their velocity; the channels are labyrinthine, the water sporting in a thousand directions as it passes along.

In general, the breadth of the river is well preserved, but in some places it is reduced to a width across which one might wing a partridge with an ordinary fowling piece.

Such a stream as this the migratory fish delight in, and accordingly when they had uninterrupted access to it, it was stocked with them to its very sources.

This series of falls and rapids I call by the generic title of the "Conewago rapids," the range of hills through which the river passes being known as the Conewago hills—being in fact the Blue ridge of Virginia and its spurs, as developed in Maryland and Pennsylvania. The rapids do not cease, indeed, at Columbia, the main elevation being found eighteen miles above and some twelve miles below Harrisburg, and there the interruption of the stream being greatest—the local name of the Conewago falls is given to the swift water.

At Columbia occurs the Columbia dam, belonging to the Susquehanna canal company, through which dam our first attempt at a fish way has been cut.

From the head of the Conewago rapids no considerable fall is encountered until the section of the Cumberland valley is effected, or until the base of the Kittatinny hills is reached. Here a new series of swift waters are en-

countered, which may be called the Kittatinny rapids, being caused by the passage of the river through the Kittatinny hills, the first spurs of the great Appalachian chain. I need not describe the topography of the Susquehanna further up; the railways passing along the valley exhibit it to thousands of travelers every day.

The fall from the mouth of the Juniata to the mouth of the Susquehanna is somewhere in the neighborhood of three hundred and fifty feet, probably somewhat less.

The mouth of the Juniata is about ninety miles above tide, and no river along the coast could probably offer more attractions to the shad than this, were it not interrupted by artificial obstructions.

In the first place, there is the Columbia dam, but that has been pierced by a fishway, which, when the fish are allowed to try it, they can and do ascend.

In the second place, however, as an artificial prevention of their ascent, the Maryland fisheries and fishing are far more potent than anything that exists on that dam at this time.

In the estuary between Bell's ferry or Port Deposit and Havre de Grace, the fishermen set out seines from each shore some fourteen hundred yards in length, the width of the river being somewhat less than seventeen hundred yards.

These seines extending from the surface to the bottom, it is very easy to understand, that they *clean out* the estuary whenever they are put in active operation, for they overlap each other, and the difficulty is to imagine how any fish can escape them.

In addition to this, gill nets, extending nearly across the stream, are set floating at the head of the estuary, and are taken up at the foot of it. The unfortunate shad that may have managed to dodge the overlapping seines are sure to be caught in the meshes of this murderous trap, and there, struggling and unable to use their respiratory organs, actually drown before the device which entraps them can be drawn to the shore. As they become disabled voracious smaller fry from the bottom—eels, gar and other species, rise from below and strip them to the very skeleton. I was informed by a gentleman at Port Deposit that he had seen gill nets brought to the shore in which twenty-five per cent. of the shad caught in one of these gill nets were reduced to the anatomical state. How many were drowned and dropped, or were drawn out of the meshes, could not, of course, be ascertained. It is certain, however, that those which are wounded or disabled by the gill nets sink and become a prey to their voracious enemies below.

The gill netting in the Susquehanna is, I believe, somewhat discouraged of late amongst the Maryland fishermen, and is not practiced so much as

formerly. It is not, however, entirely discontinued, but all must agree that it ought to be.

The seine fishing in the estuary, however, would seem to be sufficiently depletive to prevent a fair run of shad from ascending the river. There is no interruption to it except during the Sabbath hours, (in which it is prevented by a law of the State of Maryland,) during excessively dark and stormy nights, and during very high water.

This is one subject amongst others on which there should be concurrent legislation with the State of Maryland.

The Safe Harbor* and the Columbia dams blocked the ascent of the Susquehanna beyond these points for years, except to such very few strong individuals as could make their way against the currents of the navigation schutes. The result was that the annually returning shoals of fish being baffled in their ascent towards the pleasant waters to which they were bound, would back away into such pools as they could find between Columbia and tide, and there leave their spawn a prey to the prowling eel and others of the finny tribe who live by devouring the weaklings of their fellow denizens of the deep. Thus millions upon millions of the shad have been destroyed in embryo every year for nearly two score years; and yet the shad, instinctively anxious to reach the spawning beds of the upper Susquehanna, assemble at the head of the Chesapeake bay every year, only to be disappointed of the destiny which nature fairly intended for them, but which man to his own detriment averts from them. The eels even are disappointed by these obstructions, voracious as they are, carnivorous, strong, cunning, slippery; the eels being migratory in their habits, used to be found in large numbers in our upper Susquehanna; and let me say there are many varieties of fresh water fishes less attractive to the gourmand than were the eels of the upper Susquehanna thirty or forty years ago. The eels, with their serpentine forms and forceful and fraudulent ways, although to some persons unattractive—when they had the range of our upper waters, were celebrated far and near as a dainty for the breakfast table. The eels, although not entirely shut out, are prevented very much from getting up the stream by these artificial obstacles, and are driven to the rapacious and disreputable practices and courses to which I have alluded on the lower waters, and have there multiplied to a degree far beyond the necessities of the neighborhood, and tend further to deplete our river of their more favored rivals, the shad. Were things brought back to something like their original and normal state, these multitudinous wrigglers would be scattered over the whole bed of the stream, and would add their quota to the mass of cheap and excellent food, which that bed is capable of furnishing to the inhabitants of its borders.

*No longer in existence.

Let us examine for a moment the extent of what we once possessed in the way of fisheries on the Susquehanna. And first, from the New York State line, on the North Branch, to the mouth of the river, the distance is about two hundred and sixty miles. From the mouth of Bennett's Branch of the Sinnemahoning to Northumberland is something over one hundred miles, say one hundred. From Clerrfield to the mouth of Sinnemahoning is about thirty-five miles. From Hollidaysburg to the mouth of the Juniata is about one hundred miles, and from Bedford to the mouth of the Raystown Branch of the Juniata the distance is over sixty miles. Sum up the other tributaries, say the Swatara, the Codorus, the Connedoguinnet and others, at say eighty miles, and we have a distance by the thread of the streams of six hundred and thirty-five miles. Now it is fair to presume that there were fisheries at every nine miles of this whole length on the average, which would give over seventy fisheries, which on the average must have yielded not less than thirty thousand shad per fishery per season. Many of them yielded more than one hundred thousand, and in the upper waters they were never fished to one-half their capacity. This would give for the meagre fishing of the day over two millions for a season. It is fair to presume then that at that time this one river could have yielded, had it been thoroughly fished, in some seasons not less than five millions of this delicious fish.

Conceive what an amount of nourishment such a catch would furnish to the inhabitants, especially to the poor, whose scant supplies used thus formerly to be eked out, and suppose we had them now, estimating them at the value of twenty cents each, they would be worth, in money, a million of dollars. Now, there is nothing in the least unreasonable in this estimate. Consider that each female shad is capable of spawning no less than seventy thousand *ova*, each of which it is possible may be fecundated, and free the river of its obstructions, it is easy to make a calculation that such a catch as I have estimated is not at all out of the way. Nay, estimating that nine-tenths of the spawned *ova* are destroyed by the vicissitudes to which they are liable, from the moment of their spawning until their return in perfect form and full growth, the calculation would furnish results far beyond what I have estimated.

But improvements in pisciculture have recently been introduced, which will save vastly greater numbers of the spawn than may escape the dangers to which they are exposed if left entirely to nature.

The law of last year (April 9, A. D. 1868) requires that "if any concurrent legislation be necessary in conjunction with the State of Maryland, to ascertain and report such proposed legislation to the Governor, who will submit the same, with his recommendations, favorable or otherwise, without delay, to the Legislature of this Commonwealth." I have alluded

to the style of fishing adopted in Maryland, and to the effectual depletion of the stream which it cannot but be the cause of.

I respectfully submit whether there should not be certain close days in the week established at the mouth of the river in addition to the Sabbath day, which is the only close day from which Pennsylvania can derive benefit.

But there is another cause of depletion, more effective if possible than the "fishing out" of the estuary. I allude to the permission to fish by means of fish baskets, which yet exists in the State of Maryland. There are legal restrictions on the statute books of our sister State as to the form of those traps: "The meshes shall be wide enough to permit of the shad fry passing through them, and the upper corners of the laths which form these meshes shall be bevelled or rounded so that the said fry may not be injured in the passage." I don't know that I give the words of the Maryland statute, but such is the sense and meaning of it. No precaution, however, in the construction of fish baskets will prevent them from killing hundreds of thousands of the tender fry. There is scarcely a fish that glides beneath the surface of the water so easily destroyed as are the fry of shad. The slightest bruise received by them is certain death. The fish baskets on our own portion of the river murder millions of these little creatures yearly. Working down stream, as the fishermen tell me, always tail foremost, the tender fry are washed in shoals, and with violence against these rough laths, the interstices of which are soon clogged up with the dead. I heard of one below Columbia from which seven bushels and a half were taken dead last year at one time, and of several below that where it was very common to find them by the bucket full. We have passed laws in this State to abolish them entirely, and these laws must be executed or we need never hope to re-stock our waters. Concurrent legislation to the same end ought undoubtedly be suggested to our sister State. A committee of the Legislature of Pennsylvania might easily propose such laws as would be exceedingly beneficial in this regard to both States. Maryland has no doubt discovered that her fisheries on the lower Susquehanna have become very much depleted since Pennsylvania erected dams on the upper waters, thereby depriving the up runs of shad of their spawning grounds. I have it from one of the oldest fishermen on the Susquehanna below Columbia, within the Pennsylvania line—Mr. M'Call, of M'Call's Ferry—who, in a letter to Seth Green, one of the commissioners of New York, states that "there is not one shad caught now at the fisheries in his neighborhood for twenty that used to be caught before the erection of the dams above."

This depletion must extend to Maryland, and as we propose opening our dams so that the spawning grounds may be again brought into fruitfulness, thus remedying the depletion in both States; and as we have besides abol-

ished by statute the murderous fish basket, for the benefit of both, may we not ask of our good neighbor, Maryland, concurrent legislation at her hands? Besides, is there not something in the nature of a usufruct in the reciprocal rights of Pennsylvania and Maryland, as to the fisheries of the Susquehanna, which cannot be defined or settled without concurrent legislation? If Maryland can show that by the erection of dams in Pennsylvania the fishing in her portion of the Susquehanna has been deteriorated, has she not a right to ask some explanation of her neighbor?*

I suggest, then, that there ought to be concurrent legislation with Maryland, having regard to—

1. Fishing with gill nets.
2. The abolishment of fish baskets.
3. Close days.

And so shall we, in re-habiting the upper river, increase the product of that portion of it which passes through Maryland.

The fish baskets between the Columbia dam and Duncan's island have well nigh disappeared. But I am sorry to say I observed several of them still standing in the channels below Columbia. Should Maryland be induced to pass a law abolishing them, I would recommend that some effectual method be devised to suppress them below Columbia.

Let the powers of a water bailiff be conferred on some person below the Columbia dam, and make it imperative on such officer to see that these foul nuisances be abated.

The law of this year also extends the duties of the commissioner, "so as to include the consideration of, and reporting to the Governor, such action as may be necessary and practicable in view of the planting and propagation of edible fish in such of the rivers and streams of this Commonwealth as may be fitted for the same."

I do not think that the propagation of edible fish, in general, is a work to be done into by the State. When the dams shall have been opened, and it is found that shad will ascend to the upper waters of the Susquehanna, or other streams, it may be well enough for the State to assist in the re-stocking of those rivers by artificial means. But I do not consider it to be the duty of a State like ours, possessing thousands of streams, to go into the business of pisciculture.

No State in the Union has yet set the example, although individuals have introduced the art with great success. In the Appendix will be found, extracted from the report of the Massachusetts commissioners, some exceedingly interesting information as to the cultivation of both trout and shad; and the publishing of this, and the dissemination of it amongst her citizens,

*Why, also, might not New York ask a similar question of Pennsylvania, seeing that the shad were once plentiful on the upper North Branch, far within the boundary of her territory?

is as much, I think, as ought to be asked of the Commonwealth at this time. I refer especially to the portion which relates to shad, where it will be seen how easy it would be to re-fill the Susquehanna and its tributaries with our long missing favorites. [See Appendix A.]

As to other fish, private enterprise has introduced black bass into the Potomac, and now that excellent and favorite fish is to be found in that stream in very great numbers. These numbers originate from a few individual bass having been placed in the river by a Mr. Stabler, a locomotive engineer, who brought them over, in the tank of his engine, from the Ohio, about a dozen years since—not longer ago, certainly, than the middle of the last decade.

Following this example, some gentlemen of Harrisburg, Generals E. C. Williams and T. J. Jordan, Colonel John H. Ziegler and A. M. Zimmerman, Esq., all of Harrisburg, have placed one hundred and sixty of that same favorite fish in the Susquehanna, at Harrisburg, and it is not doubted that these will multiply until the river shall be thoroughly stocked with them. I understand that some few have also been introduced into the Juniata by private enterprise.

The Susquehanna salmon, as it is called incorrectly, the ichthyologists not classing it with the salmonidæ, but with the percidæ, I believe, is and always has been celebrated as a dainty dish for the table, and is known nowhere to reach the perfection which it does in our stream. This fish has suffered with the rest of our Susquehanna tribes, but some individuals, and very fine ones too, continue to be caught every spring. The yellow perch and the rockfish have both become scarce by the carelessness with which the river has been guarded. All these admirable fish might be increased indefinitely if laws were passed protecting them for a few years, and those laws faithfully executed. The subject is worthy of the most serious consideration.

The great authority on fish propagation in the United States at the present time is Mr. Seth Green, of Mumford, Monroe county, New York, to whom I respectfully refer those citizens who wish information on the subject. And in this connection I report in the Appendix B an interesting letter from Mr. Thaddeus Norris, of Philadelphia, who has published a work on the subject.* Mr. Norris's letter speaks for itself.

The Fish Commissioners of the New England States, New York and Pennsylvania, met in convention at the Fifth Avenue Hotel, New York, on the 29th of December, 1868. I consider their deliberations so interesting that I submit a condensed report of them in the Appendix to this report. It will be seen that it is their united opinion that very much can be

*American Fish Culture, embracing all the details of artificial breeding and rearing of trout, the culture of salmon, shad and other fishes, by Thaddeus Norris. Philadelphia, Porter and Coates; London, Samson, Low, Sons & Co., 1868.

done to bring back our fisheries to their former abundant supplies by judicious legislation properly carried out. [See Appendix C.] Our fisheries have chiefly suffered for the reason that they have never been properly regulated by law.

Let even the recommendations of this present report be carried out, and the consequences will prove salutary in a high degree. Let proper reciprocity laws regulate the fisheries of Maryland and Pennsylvania. Let piratical fishing be stopped. Let the indiscriminate and continuous slaughter of fish, at and near our fish weirs in the running season, be discontinued. Let the newly introduced fish be protected, which will incidentally protect those native to our rivers, which have been reduced in numbers by unfair fishing. Let the opening of the dams be persisted in as soon as it shall have been ascertained at whose cost the openings shall be made.

We have much reason to congratulate ourselves on our success as far as we have gone, and as we gain in experience our success will be in proportion.

The suit against the companies demurring to the law of 1866, and refusing to open the dams, was tried in Dauphin county, in December. The subject was fairly laid before the court and ably argued on both sides. Up to this writing no decision has been reported; but be the decision what it may, the dams ought to be opened for the passage of fish. The people have been too long deprived of this right—a right which remains undisturbed under the most despotic governments of Europe. It is indeed a wonder that in a country like ours, where the people have all the power in the hands, they have submitted uncomplainingly for so many years to a deprivation that no other people in Christendom have been called upon to bear. It is only another proof that where the greatest freedom exists there will be found the most law abiding citizens. I started with the statement that it is surprising that any fish at all are caught in the upper waters of the Susquehanna—and when you consider the gauntlets that the fish have to run from their first spawning until they are able to return—it is indeed a wonder.

Fish baskets at almost every shoal on the river, from the spawning beds to the mouth, catching bushels of the fry in their descent—overlapping seines for the whole length of the estuary. Gill nets to take and murder the few who escape the seines. Fish of prey prowling for the spawn and the fry in every place where they are likely to be found. With all these causes operating we find that the opening of the lower dam has, for two years in succession, given proof that if we persist in our efforts, we shall have the fish back again. Let us then persist to the end. All the States north of us are now exerting themselves with the same laudable purpose, and all their experience goes to show as ours goes to show, that judicious

legislation on this subject, properly carried out, will be crowned with ultimate success.

The expense, which is not large, incurred in our law suits with the corporations, when exactly ascertained, will be duly reported.

I am, very respectfully,

Your obedient servant,

JAMES WORRALL,
Commissioner, &c.

APPENDIX.

[A.]

ARTIFICIAL BREEDING OF TROUT AND SHAD.

The artificial breeding of fishes is, in theory, familiar to most people, but in practice, very little is known of the necessary details.

In France, thanks to the labor of Professor Coste in carrying out the discoveries of Joseph Remy, pisciculture has become a true industry. The Imperial establishment at Huningue, founded fifteen years ago, produced, in 1861, 16,000,000 of eggs. These were of several species (all, however, of the Salmonidæ), viz: the Fera (*coregonus fera*) which is like our white fish; the Ombre chevalier (*salmo umbla*), called, in the Tyrol, Sälbling, and in England, Charr; the large and valuable Danube salmon (*salmo hucho*), called Huchen by the Germans; the great trout of the lakes (*salmo trutta*), which is the Seeforelle of the Germans, Truite Saumonnee of the French, and sea trout of the English; the common salmon (*salmo salar*), and the European brook trout (*salmo fario*), called Forelle by the Germans. This excellent establishment is (or was) nevertheless defective in two respects; first, in the imperfect means of getting eggs, which are collected at distant points, and consequently arrive often in bad condition; whereas, so extensive and well appointed a place should, in most cases, raise or keep its own breeding fish; secondly, in the small variety of fish cultivated, and those all of one family. All of which is said, not to criticise what has been effected, but to point out what may be in future expected. To breed trout successfully there are needed (1,) good and abundant water; (2,) proper apparatus; (3,) a regular supply of breeding fish; (4,) general skill and care in the operation; (5,) plenty of food. The water should be of a spring; pure, clear, at near 47° the year round as may be. Moreover, it should flow constantly. To avoid the mud and overflow of freshets, the breeding ponds should never be in the main stream. But this should be dammed, (*Pl. III, fig. 2, d*), and from the mill pond thus made, a canal or a flume (*Pl. III, fig. 2, hh*) should be led to supply the needful water. At the mouth of this canal may be a sluice-gate against freshets, and there must be, also, a barrier to prevent the escape of the fish. (*Pl. III, fig. 2, a c*.) This may be either a water-wheel moving below in a casing (*Pl. II, fig. 6*) and turned by the current, or, if there should be a little fall, a horizontal raised grating may be placed just under it. (*Pl. II, fig. 4*.) These contrivances are better than a vertical screen, which gets clogged with leaves, &c., and does permit floating food to pass, which is a very important item. This food consists of an immense variety of organisms, such as larvæ of dragon flies, minute crustacea, water worms and beetles, young fishes, aquatic snails, &c., &c. Its quantity may be increased by placing a slanting boom at the mouth of the canal in such a way as to turn into it whatever the current brings down. (*Pl. III, fig. 2, n*.) The lower part of the

canal should be about four feet wide and two feet deep, and its bottom should be of clean gravel, while the top is loosely covered with boards. (*Pl. III, fig. 2, bb.*)

This is the spawning bed. Beyond comes a pool or a pond (*h. k.*) for breeding fish, and furnished with a screened outlet (*o.*) Such a pool should be four feet deep, and its bottom weedy or earthy, and in no case covered with gravel. Other and smaller pools may be provided for the young fish of different sizes, (*m. m.*) each with a good conduit of running water (*e.*) and a screened outlet (*o.*) The hatching house (*Pl. III, fig. 2, l; Pl. II, fig. 5*) must also be supplied by a conduit of running water (*Pl. III, fig. 2, e; Pl. II, fig. 5, a.*) and with a screened outlet, (*Pl. III, fig. 2, o.*) This building is a simple close shed with small windows which can be darkened at pleasure. (*Pl. II, fig. 5, e. c. e.*) Within are double ranges of shallow troughs (*c. c. c.*) communicating by little sluice gates (*fig. 3, e.*) with a supply trough, (*fig. 5, g; fig. 2, d.*) which, in turn, is filled from the lower end of the conduit (*a.*) outside the building. This lower end is fitted with three flannel strainers (*b. b. b.*) through which the water passes, and then enters the supply trough through a little sluice gate. (*Fig. 3, c.*) These strainers should be placed at an angle, so as to present much surface, (*Pl. III, fig. 5, a.*) and should be made to slip in and out, so that they may be frequently washed. Moreover, a sluice gate should always be placed below strainers, (*b. c.,*) otherwise it gets clogged by leaves, etc. Each spawn trough (*Pl. II, fig. 3, f.*) in the range is eighteen inches long by twelve wide, and is separated from its neighbors by a ridge one and a half inches high (*h.*) The sides may be as high as eight inches, which gives a chance to back up the water, and make a trough of that depth, after the fry hatch. The water furnished to each single range by the sluice gate (*e.*) should be equal to an inch stream with a three inch head. The water runs down the range with a gentle current about an inch deep, to secure which a fall of one inch in six feet is enough. Hatching troughs are usually made of wood, with a bottom of half an inch of perfectly clean gravel about the size of peas.

But unquestionably some sort of glazed pottery or coarse glass would be much cleaner, and not liable to the black mould which appears on wood, (especially where there is a knot,) and which, penetrating the gravel, destroys the spawn. In Europe, the ova are placed on glass bars, but it would probably suffice to have the bottom of the pottery trough made rough and uneven, so that the ova should be raised, to allow a flow of water under and about them. After flowing the length of the range the water falls through a wide cut in the floor (*h*) and passes out under the shed. In addition to the strainers above mentioned, it is well to make one or more piles of gravel in the supply trough, which act as filters. To render the hatching house comfortable in the winter, a stove (*f*) may be placed beyond the troughs. The pools, if four feet deep, twenty-five broad, and forty long, will each contain several thousand breeding fish, weighing from half a pound to a pound and a half. The bottom is left earthy, in order that they may not deposit their spawn on it. As soon as late autumn approaches, the trout pair, and seek the congenial gravel of the covered spawning bed. (*Pl. III, fig. 2, b. b.*) Once or twice a day the entrance to the spawning bed is suddenly closed by a bag, the mouth of which is held open by a wooden frame, then the boards are thrown off the trench, and the spawners, seeking to escape into their pool, are caught in the bag, whence they are gently transferred (by untying the bottom) to a tub of clean water, which is at once taken to the hatching house. In this way none but ripe fish are secured, and those in the pool are not bothered by being constantly netted and examined. Each trout is now taken in turn from the tub, and held

over a milk pan half full of pure water. The fish should lie on its back, on the sleeve of the right arm, which should be covered with cotton flannel; the right hand grasps gently but firmly the body just above the tail, the left hand rests below the gills, and near the pectoral fins. (*Pl. III, fig. 3.*) The animal, being thus firmly held, the forefinger of the left hand is passed repeatedly down the belly, with a slow, steady, and moderate pressure, and the ova flowing out falls into the pan of water. The male fish gives out in like manner the seminal fluid, which looks like thick milk. Each fish, after being stript, is quickly put in another tub, and the whole are at last returned to their pool. This operation requires some dexterity, otherwise the fish get bruised, which is liable to produce on them a fatal vegetable growth. They are said to be much more docile in fine weather than in stormy, when they are apt to flap about and hurt themselves. For very large fish, like salmon, it is convenient to have a second man, who holds the tail, giving the other full use of his left hand. It is not necessary to pay attention to the different *pairs* of trout; males and females may be taken indiscriminately, and the product of the whole mixed in a common pan. The water now assumes a milky tinge, from the milt of the male, while the ova sink at once to the bottom, and there *stick fast*. They appear as little round bodies, about three-sixteenths of an inch in diameter (or larger, if the parent be large,) of a pale yellow or an orange hue, according as the parent has white or pink flesh.* They must be left in the pan as long as they will stick, which will be fifteen or twenty minutes.† Then the water must be gently drained off, fresh water poured in, and this washing repeated once or twice. And here is the golden rule for treating eggs of fishes; never *touch* them, but move them, by *moving the water* in which they lie. The washed eggs are now ready to be spread in the hatching trough, which is done by tilting the pan and allowing them to slide gradually out, so that they do not lie on top of each other, and are not overcrowded. They may be further arranged by agitating the water with a turkey's wing feather. There may be placed about four thousand in each square, which is eighteen by twelve inches. They should be allowed to remain undisturbed, but should be constantly watched, and those which die or are attacked by mould, should be removed with forceps. The minute vegetable growth, so fatal to eggs, and even to young fish, is very likely a true *conferva*,‡ at least we may judge so from Vogt's description of the parasitic plant that attacks the eggs of *Coregonus*. To avoid it the precautions are: 1st, pure running water of the right temperature; 2d, very clean gravel washed in boiling water; 3d, the use of wood for troughs that is well dried, and free from knots and acid juices; 4th, the protection from dust, dirt and sediment; 5th, protection from strong sunlight. Green discovered this by observing that, where a band of sunshine fell from an uncovered window across the troughs, the ova within that limit died. A dead ovum may readily be recognized by its dull opaqueness. It looks like a drop of tallow. Furthermore, the troughs should be guaranteed against mice, water insects, and snails. Where sediment chances to settle on the ova, the water should

*The color of the flesh plainly does not depend on the crustacean food which the trout gets, according to the theory of J. r. Gunther. Trout raised in Green's pools, and having the same chance for food of this kind, are sometimes pink and sometimes white fleshed. There is some reason to think this peculiarity is hereditary.

†This *temporary sticking* is an extraordinary provision of nature, to enable the eggs to cling to the bottom, and resist the current, until the parent has had time to cover it by sweeping gravel over it with her tail. It is probable that Vogt has mistaken in supposing the eggs of salmonidæ had no viscous coat; it is perhaps in a soluble form. *Agassiz and Vogt in Poissons d'eau douce.*

‡See Kutzing Fr. R. Phycologia generalis. Plate 11.

be stirred with a feather until the current has carried off the deposit. If spawn is to be sent away, the best time is from twenty to forty days after impregnation, when the eyes show through the eggs as two black specks. Take live moss, with long fine stems, and wash it till perfectly free from dirt. Place a layer of it, while moist, in a tin box with holes in the bottom, place therein a layer of spawn, then another layer of moss, then another of spawn, till the box is full. Put on a tin cover firmly and pack the box with sawdust in another and considerably larger one. If kept cool the spawn will be good for at least fifty days, and it has been thus preserved for eighty-five days. The best temperature is about 50°. At over 65° eggs suffer severely. The minimum time for hatching is fifty days,* the maximum one hundred and fifty days. Then the little troutling lies feebly on its side, and for forty-five days subsists entirely on the gradually absorbed yolk sac, which in nature seems to serve the double end of food and of an anchor to hold it down among the gravel. At the end of that period the little fish is free, and needs feeding. Now the water should be backed up several inches deep in the troughs, and the fish fed twice a day with raw beef liver, cut as fine as jelly, and bruised with water, and very slowly given to them, so that it may be eaten up clean. It is still necessary to keep the troughs perfectly clean, and to maintain a constant current. At the end of two months feeding the fry may be removed to small pools out of doors, (*Pl. III., fig. 2, m, m.*) and at this, or a subsequent time, may be sent long distances, in a can of water or a tank, (*Pl. III., fig. 6.*)

The successful growth of the fish now depends on (1) plenty of food, (2) proper water of a *sufficient depth*. A little trout, kept in a shallow hatching box, will cease to grow at three or four inches, feed him never so much. Water is to be had in plenty, but *food* is the turning point of profit or no profit in fish breeding. The little ones will get enough food in a proper pond or brook, if simply left to themselves; but to grow the larger fish rapidly, extra food in large quantities will be required. The way to get this is the way of Commachio; to breed one fish to feed another, and to let the first gain its own living from insects or water plants. Near the seacoast vast quantities of little fish may be had for the catching; among which may be named the "friars" (*fundulus*) that swarm in salt water ditches and creeks. These, scalded and given to trout, produce a rapid growth, some getting to half a pound and more in a year. There seems no reason why every inland fish breeding establishment should not hatch, artificially, large quantities of small fish entirely as food for the more valuable trout. Probably the cyprinoids ("shiners") would be the best, because they breed rapidly. A certain amount of beef liver could be used to advantage, but would be too dear and too hard to get for a constant food. The shiners would be kept in small ponds, whence the pickerel and pouts had been removed, and where they would get their own living. The breeding establishments already in existence depend for their profits chiefly on the sale of spawn and young fish. With them this question of food for their breeders is not so important. Besides the ponds of Seth Green, at Mumford, near Rochester, N. Y., there are those of Rev. Livingston Stone, Charlestown, N. H.; Benjamin Kilburne, Littleton, N. H.; J. D. Bridgman, Bellows Falls, Vt., and Mr. J. S. Robinson, Meredith, N. H.

But all these, however creditable, so far as they go, are, in comparison with what should be, mere boys' play. A trout breeding establishment should have five artificial ponds of an acre each, and four feet deep. These would hold one million of marketable fish. It should have two or three

*Mr. Stone has, however, hatched trout in thirty-five days, in water 55 degs.

natural ponds, of a dozen or twenty acres each, where fish could be bred wherewith to feed the trout; and finally, it should have pools for the breeding fish, and hatching houses in proportion to the quantity to be raised. If other species were cultivated, a proportional number of ponds would be necessary. Salmon for breeding should be treated like trout. They should be taken in nets, (from a late run if possible,) and confined in a running stream of some depth, and of a proper bottom, with shady banks and with hiding places. From the stream should lead gravelly, covered trenches, suitable for spawning beds, into which the pairs of salmon would go in their season, and whence they could be taken for breeding. The only difference would be, that whereas the trout are kept from year to year, the salmon must be returned to the river in order that they might go to the sea. Seth Green, who sat two days in a tree to watch the salmon spawn, corroborates the account given by Shaw* a quarter of a century ago. The nests, or excavations, are made not with the nose, but with the tail. Many of the ova are neither impregnated nor covered, and are carried down stream, where shoals of trout await them. The method of the trout is almost identical. The female lies close to the bottom, with her head up stream, and gently fanning with her tail; a few inches above lies her mate, keeping a sharp lookout for all intruders, at whom he darts furiously whenever they approach. Even the female rushes at them when they are numerous. From time to time she, by a spiral contortion of the body, brings her tail with a strong sweep against the gravel, and this, after a while, makes a rough depression or "nest." Over this she stays and begins a kind of serpentine motion of the body, the object of which seems to be to work the eggs from the ovary into the abdominal cavity. Presently the ova are ejected with a convulsive tremor of the muscles, and simultaneously the male throws the milt into the water. The eggs are covered in part by the current, in part by the tails of the fish; but many are not impregnated at all, and many more are swept down stream, where they are eaten by expectant fish. The trout themselves, too, come on the spawning beds, and root the gravel with their noses, and then fall back, watching for eggs that may be washed out. Trout, however, will not eat their young, if they can get other food.

It may be noticed that trout are here mentioned as if there were put one species (*salmo fontinalis*) in our ponds and brooks. This may or may not be. Doubtless artificial breeding will throw light on this question before many years have passed. Our trout shows many variations even in neighboring localities. Old John Trout, the veteran angler of Webster's day, could distinguish unfailingly a fish from Monument river, Red Brook, or Marshpee Brook (all streams emptying near each other on the south side of Cape Cod,) and that not from color, but from shape. The Dublin lake trout of New Hampshire are well known for their peculiar delicacy of form.†

Now it will be the study of intelligent breeders to obtain these different forms, and breed them together; then, to take their progeny and breed *them* together, to see if the second generation be fertile among themselves, and to observe all the forms produced by the different interchanges. Well determined species, too, should be taken; the salmon artificially impregnated by the trout, if this be possible, or the white fish tried with the salmon, in

* Royal Society, Edinburgh, Vol. XIV, 1840.

† As to color, it counts for little; and it is commonly known that it varies according to the hue of the bottom. It is *not* commonly known, however, that the trout changes front almost like the chameleon. A fish from a white gravel going suddenly over dark weeds, for a few moments stands out as a light spot against an obscure ground, but soon it shades off, and in perhaps two minutes is similar to the new bottom over which it lies.

order to determine the limits of inter-fertility. Such experiments might be continued almost indefinitely, and with the greatest advantage to science! Then some of the little land locked brook trout of Cape Cod should be marked and placed in a situation to seek the sea, if they chose so to do; when re-taken, we should find out whether they *did* go to the sea, and whether they proved identical with the sea trout, so called, which there reach a weight of three pounds, or three and a-half pounds. These sea trout come up into the brooks in the middle of May, spawn in October, and return lean in November to the sea, where they recuperate; for they are fat in winter, though not highly flavored. They go well out, as is plain from the fact that they are occasionally taken several miles from any stream or harbor. The little yellowish "natives" remain in fresh water; but these may be only the parr form of the same species.

ARTIFICIAL BREEDING OF SHAD.

Early in last summer, Seth Green offered to come, at his own expense, and try to hatch the eggs of the shad at Holyoke, provided the New England commissioners would furnish the necessary apparatus. This man bids fair to prove the Remy of this country, not because he has succeeded in hatching a certain number of trout, but because he has originality, as well as skill, and large ideas, as well as originality. He has a living faith that our rivers, ponds and bays may, by artificial breeding, be so filled with fish, that, to use his own words, "the people can't catch 'em out, if they try." With more truth than fancy, he says, "Let your State spend a tenth part in planting fish, of what it spends in planting corn, (that don't pay for the raising,) and every poor man may have a fish dinner the year round." The newspapers and periodicals have spoken of him, only to say that he is a noted sportsman. To be a crack shot, and to throw a fly eighty feet, are things of no great matter, but to increase and cheapen the food of a whole people, is worthy the devotion of a lifetime.

Green began his experiments the first week in July. He put up some hatching troughs, like those already described, (*Plate II., figs. 3 and 5,*) in a brook which emptied into the river. Having taken the ripe fish with a sweep-seine, he removed and impregnated the ova in the way already described for trout. These, to the number of some millions, he spread in boxes; but, to his great mortification, every one of them spoiled. Nothing daunted, he examined the temperature of the brook, and found, not only that it was 13 degrees below that of the river. (62 to 75 degrees,) but that it varied twelve degrees from night to day. This gave the clue to success. Taking a rough box, he knocked the bottom and part of the ends out, and re-placed them by a wire gauze. In this box the eggs were laid, and it was anchored near shore, exposed to a gentle current that passed freely through the gauze, while eels or fish were kept off. To his great joy, the minute embryos were hatched at the end of sixty hours, and swam about the box, like the larvæ of mosquitoes in a cask of stagnant water. Still, though the condition of success was found, the contrivance was still imperfect; for the eggs were drifted by the current into the lower end of the box, and heaped up, whereby many were spoiled for lack of fresh water and motion. The best that this box would do, was ninety per centum, while often it would hatch only seventy or eighty per centum.

The spawn box he at last hit on, is as simple as ingenious. It is merely a box with a wire gauze bottom, and steadied in the water by two float bars, screwed to its sides. (*Pl. II., figs. 1, 2, 7.*) These float bars are attached, not *parallel* to the top line of the box, but at an *angle* to it, which makes the box float with

one end tilted up, and the current striking the gauze bottom at an angle, is deflected upwards, and makes such a boiling within, as keeps the light shad eggs constantly free and buoyed up. The result was a triumph. Out of ten thousand ova placed in this contrivance, all but seven hatched! In spite of these delays, and of the imperfect means at hand for taking the fish, Green succeeded in hatching and setting free in the river, many millions of these tiny fry.

As no way is now known of keeping shad in ponds or pools, they must be watched at their breeding grounds, and when the spawn begins to flow freely from them operations may commence. The fishing must take place by night, because (near Hadley Falls, at any rate,) no ripe females are captured by day; those taken are all spent or not yet ready to lay. This may be because they are in the deep holes, spawning, or because they are above in the quick water. The seine must not be hauled quite ashore, but the bight of it must remain in the shallow water, that the fish may be kept alive. Thence they are taken out, and the spawn impregnated in a tub or a large pan of water. Many scales will fall in the water, and must be carefully picked out before the ova are distributed in the floating boxes, wherein they may lie about one-fourth of an inch deep. The boxes must be lashed end to end, in lines of convenient length, and it is well to surround them with a log boom, to keep off rubbish brought down by the stream. They should be placed conveniently near the shore, in a gentle current, but not so near as to risk being left dry by a fall of the river. They will now appear as if they had nothing in them, for the eggs are almost as transparent as the water itself; but if they turn milky, and look like half-boiled sago, they are spoiled.

The contents are not, however, to be thrown away, without taking up some in the hand, when it will likely appear that but a small part are added, while the rest remain transparent. With further progress the embryo may, with a weak glass, be easily seen moving in the egg, which then is not so clear, and at the end of sixty hours (with sunshine and water at 75°) the box will be found alive with tiny fry, almost transparent, except the eyes swimming freely, with their heads up stream. In confinement they cannot be kept, because the yolk-sac does not suffice for their support for more than one or two days. But care must be taken to liberate them in a *safe place*. Green observed that, on setting them free among the shallows near shore, the dace (*Argyreus*) and other little fishes rushed to the spot, and commenced jumping at them. In the stomach of a dace, he found fourteen shad fry. Then by a series of most ingenious experiments, he discovered that the fry, so far from frequenting the shallows, like many minnows, *made directly for the main current, in mid river*. How different this from the young trouts that lie almost helpless for forty-five days, and then are fain to hide behind stones and roots! Whereas, these minute, transparent, gelatinous things push boldly for the deep, swift current, where they are too insignificant to be attacked by the great fishes. Will the physicists tell us what "correlation and conservation of force" produces this, or will the Darwinians set forth how, some millions of years gone, a particular shad fry, finding by accident that he did not get eaten in deep water, transmitted a deep-water instinct to his children, who thereby flourished, while the shoal water fry got in due time exterminated?*

So the fry must be let go in the proper way by towing the boxes into mid stream, or by liberating them during the night, when their enemies do not

*Did it ever occur to any body that the Darwinian hypothesis was, after all, suggested by Lamb's "Origin of Roast Pig?"

feed. In either case the trap-slide (*Pl. II., fig. 2, d.,*) must be raised, when they will be carried gradually through the coarse netting by the current. This operation must be performed as soon as all the ova are hatched out. There ends the nursery care; for we know no method of keeping the young till they have gained size and strength. What we may hope to avoid is, the enormous loss which the eggs themselves suffer, when deposited by the natural method.*

The ovaries of a full-grown shad (*Alosa praestabilis*) weigh at the spawning season about thirteen ounces, without the membranes. With a common lens, three sizes of ova are at once distinguished. The first have a diameter of eight one-hundredths to nine one-hundredths of an inch. These are transparent and ready to be laid; the second, four one-hundredths to five one-hundredths of an inch; the third, two one-hundredths of an inch. These two smaller sizes are opaque; they are still found after the fish has spawned, and are the crops ready to mature the next year and the year after. This state of the ovary † has its parallel in the turtle, and possibly in all of the vertebrata.

It is scarcely necessary to add that the microscope shows other and smaller ovarian eggs. An ovary of the size above mentioned contains about seventy thousand ova, ready to be laid. Their diameter increases, as soon as they are put in water and impregnated, from nine one-hundredths to thirteen one hundredths of an inch. This is by the endosmosis of water between the yoke and the shell membrane. ‡ Of the embryonic development, we have, as yet, only an imperfect outline to present. Forty-one hours after impregnation, the condition of the embryo is, on the whole, in advance of that of *coregonus* on the thirty-third day. § The under surface, from the nose to the beginning of the ventral, is in close contact with the yolk, which is composed of a great number of rounded divisions, such as are seen in the complete segmentation of that body, while its surface is flecked with pigment stars, (*Pl. I., fig. 1, d.,*) of which a less number may be distinguished on the forward part of the trunk. That part of the embryo which swings free makes a spiral half turn, so that the dorsal fin is turned toward, instead of from, the yolk sac. The head, which is pointed in front, and flattened, bears no resemblance to that of the grown animal, and it would be perhaps fanciful to compare it even to such forms as *Petromyzon* (Lamprey eel.) A large portion of it is occupied by the eye, which fills proportionate at least four times more space than in the adult, (*figs. 1, 2, 3, b.*) The choroid coat, not yet closed below, partly encircles the crystalline lens, above which may be distinguished a clear space, which is a portion of the vitreous humor. The form of the brain may already be distinguished, especially when fore-shortened from the front, (*fig. 3, a.*) It is probable that the pectoral fin already exists, but, from the extreme transparency of the tissues, its outline could not be caught. From the well marked nuchal bow, (*fig. 1, n.,*) the flattened body tapers gradually to a fine point, and is bordered, above and below, by an embryonic dorsal and ventral (*fig. 1, e g.,*) which spread into a spatula like caudal fin, (*fig. 1, f;*) and it should be ob-

* With the utmost care to secure every favorable surrounding, Green was never able to hatch more than two per cent. on the natural river bed. Only those eggs hatched that chanced to catch in an angle of the gravel, where they had the current all about them. This does not take into the account those that are not impregnated, or are devoured, or covered by mud, &c., &c.

† Agassiz, L., *Contrib. to Nat. Hist. of U. S.*, Vol. II. p. 489.

‡ The same takes place in a less degree in the egg of the *Coregonus* (white fish.) (Carl Vogt, *loc. cit.* p. 27, Pl. 1, fig. 9.) Accustomed only to eggs of trout, Green was much astonished to behold the mass of ova swell to near twice its first bulk.

§ Vogt, *loc. cit.* Pl. 6, fig. 142.

served, that neither in this stage nor in the newly hatched, (*fig. 4, e, f, g,*) does there exist any unevenness of the margins of these fins, that should indicate their approaching separation; whereas, the newly hatched salmon (*Pl. III., fig. 1, b, c, d, e, f,*) already shows very distinct dorsal, adipose, caudal, anal and ventral fins; and the little *Coregonus*, though less advanced in this respect, shows plainly the boundaries of these organs. Near the base of the caudal is now to be seen the end of the alimentary canal, passing at an angle across the breadth of the fin. (*Pl. I., fig. 1, h.*) The heart may be observed beating, and the embryo itself moves itself round and round within its prison, by a series of convulsive jerks. This motion is called by the breeders, "life in the egg."*

The specific gravity of the eggs at all stages is very small—barely enough to sink them, in still water—a great contrast to those of the trout, which go down almost like shot.

The newly hatched young is thirty-seven one-hundredths of an inch long, (*figs. 4, 5.*) It swims actively by a continuous and rapid vibration of the body, and keeps its head to the current, perhaps to get the food that is carried past.† The yolk sac, whose longer diameter already in the egg, was parallel with the body, now appears still more ovoid in form, (*fig. 4, d.*) The pectoral fin (*fig. 4, k,*) is easily seen, and the finger like canals in it indicate that its rays are forming. The embryonic dorsal, caudal and ventral fins are continuous one with another, and extend round the whole body back of the yolk sac. In the caudal a few faint, radiating fibres indicate the formation of rays. The choroid has completed its circle, (*fig. 4, b,*) and the eye has nearly the outward look of that in the adult. Along the course of the alimentary canal, quite to the anal opening, (*fig. 4, h,*) and over the yolk sac, the pigment stars are more numerous and defined. A little indentation indicates the mouth, which lies under the eye, and opens as a curved slit. (*Fig. 5, c. Compare that of the salmon, Pl. III, fig. 1.*) The general mass of the brain (*Pl. I., fig. 4, a,*) is easily made out. Along the centre on the body, a more translucent stripe indicates the dorsal cord, (*fig. 4, o,*) above which the range of muscular bundles begins to be distinct (*fig. 4, m.*)

Within eighty-two hours after hatching, (*figs. 6, 7,*) great development has taken place. The tail, though not forked, has taken on its triangular form, and is made up of fine, radiating fibres (*fig. 6, f.*) The embryonic dorsal and ventral (*fig. 6, e, g.*) are reduced in breadth, whereby the anal opening (*fig. 6, h,*) is brought close to the body, and at the point *l* (*fig. 6,*) may be seen the base muscles of the true dorsal, beginning to form. Along the body the transverse muscles (*fig. 6, m,*) show themselves distinctly both above and below the lateral line. The pectoral fins (*fig. 7, k,*) have now their fibres complete, and resemble two little flat brushes. The mouth (*fig. 7, c,*) is pushing forward towards its normal place. It seems to have, in the under lip, a notch, perhaps the point of future union of the maxillaries. The yolk sac (*fig. 7, d,*) no longer plays an important part, and is reduced to very small dimensions. But the most striking change is the development of gills, four on a side, and each in its gill pouch (*fig. 7, i, i, i, i.*) The gills themselves can be distinguished, like little bows, along which run their veins and arteries. These, together with the size and

*In this stage Green succeeded in keeping eggs alive in damp moss for six days, in a low temperature. But they are very hard to transport long distances, and cannot be hatched in cold water.

†The current carries the fry gradually seaward. Hence it is, that since the erection of the Holyoke dam, young shad are no more seen there; because by the time they are large enough to be noticed, they have all drifted lower down the river.

position of the eyes, give the under surface of the head, rather the look of that of a skate embryo than of a shad.

Such is a hasty sketch of three periods of embryonic life in this *Alosa*. The young, at three months, outlines have already been given.* It should be added, that their jaws are, at this age, armed with fine, sharp, slightly curved teeth, nearly continuous along the upper maxillary and intermaxillary pieces, with a few at the point of the lower maxillaries. None, apparently, on the vomer. These are necessary for the capture of the water beetles that then constitute a part of their food. The jaws of the adult are, as is well known, smooth.†

Of the further growth of the shad we cannot as yet speak with certainty, although there are pretty good grounds for an opinion. Mr. Frederick Russell, late commissioner from Connecticut, first called attention to some small *Alosæ*, about nine inches long, called by the fisherman, "chicken shad," or "Connecticut river alewives." He was led to consider them partly grown fishes, from the fact that they all were *males*. Of many hundreds examined, only one female could be found, and there the ova were not developed. The fish taken for artificial breeding, at Holyoke, were then compared, and it was found that they were of three, if not of four distinct sets or sizes. The smallest were the "chicken shad," and were all males;‡ the next were but half the size of the largest, and were males and females; so also were the largest of all. Hence we may at least guess that the young of the autumn go down, as minnows of four inches, to the sea. The next spring the males are fecund, (so too in the salmon parr,) and seek the fresh water, urged by the sexual instinct, and are the chicken shad or yearlings. Not so the females, which, not yet sexually developed, remain in the salt water, or in the estuaries. When two years old, both sexes are fecund and seek the river together. These are the half-grown or two year olds. The third season they are large fish, and may be termed three years old. But these three year olds have, in the ovary, at least two crops of eggs ready, though undeveloped, for the next two seasons. Nature does not prepare her seed only to die. Old fish: become barren § These two crops of eggs are to be laid, and for that the fish must live at least two years more. The impression that prevails among fishermen, both here and in Europe, that shad die after the spawning, the first year, comes only from the familiar fact that fishes are in meagre condition after spawning, and that some of the weaker probably do die, and are seen floating. There was a similar idea about lamprey eels, which was to the effect that they made fast by their sucker and then slowly decayed.

*Report for 1866. *Plate, figs. 1, 2, 3.* Merely outline drawings of fish from three to four inches long.—J. W.

†This brings to mind that the eternal "white bait" controversy has recently come up in England, in its usual crude form. The fish is a small clupeoid that comes in shoals, at certain seasons, into the Thames and some other English rivers; and, when fried, furnishes a poor excuse for good wine. Periodically, there is somebody who begins to wonder what the white bait really is. So, in the *Fall Mall Gazette*, of October 29th, Mr. Francis comes out with a column and a half of fine print, to say that he once caught some little fishes that, to his mind, were young herring; and that they looked, according to his memory, a good deal like white bait. *Ergo*, white bait are young herring! He is followed by two or three other correspondents with equally important remarks. Now it may be that white bait are young herring, but Mr. Francis does not prove it. Therefore, we must be content with Valenciennes. (Cuvier et Valenciennes *Hist. Nat. des Poissons*, vol. xx. pp. 30 and 341, 1847,) who, thirty years ago, declared that the white bait was not only not a young herring, (*Clupea herengus*,) but was even of a different genus (*Rogenia alba*.) And, as he was one of the best European ichthyologists, and as he devoted two hundred and twenty pages to the detailed consideration of the former fish, his authority ought to stand until somebody has examined the question as carefully as he.

‡ This sexual peculiarity is well known also to some of the Merrimac fishermen.

§ Consult von Siebold. *Susswasserfische*.

EXPLANATION OF PLATES.

PLATE I—*Embryos of the Shad.*

a, brain; *b*, eye; *c*, mouth; *d*, yolk-sac; *e*, embryonic dorsal fin; *f*, caudal; *g*, embryonic ventral; *h*, anal opening; *i*, *i*, *i*, *i*, gills; *k*, pectoral fin; *l*, muscles of the dorsal fin; *m*, transverse muscles of the body; *n*, nuchal bow; *o*, dorsal cord.

FIG. 1.—Embryo, 41 hours old, in the egg; from life.

FIG. 2.—Head of the same from above.

FIG. 3.—Head of the same from the front.

FIG. 4.—Embryo, just hatched; from life.

FIG. 5.—Head of the same, seen diagonally.

FIG. 6.—Tail and hind body of a young fish 82 hours after hatching. Alcoholic.

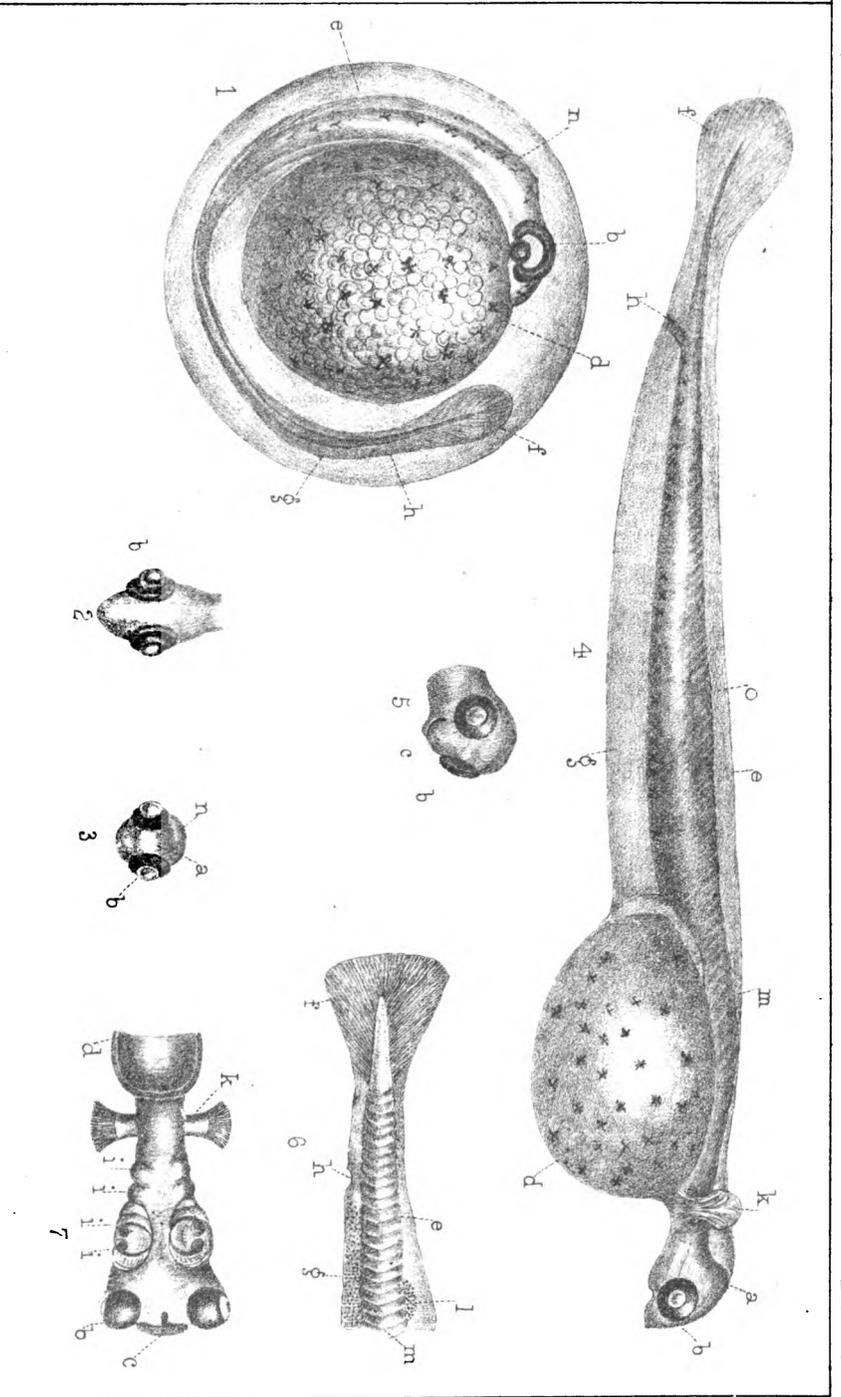
FIG. 7.—Head of the same from below. All the figures are enlarged 17 diameters.

PLATE II.

FIGS. 1, 2, 7.—Green's patent hatching box seen from the side, end and bottom. Scale 1–20th. *a*, side floats 3.4" long; 2" by 3" square, set with screws. *b*, bottom cross-bar, bevelled, to throw the current upward. *c*, wire-net bottom 14 wires to an inch. *d*, trap in hind end for escape of young fish, covered by wire-net, 8 to an inch, and with a covering slide. *e*, anchoring cord. *f*, water-line. *g*, spawn.

FIG. 3. Upper part of a hatching trough. The water comes by a conduit, *a*, through strainers, *b*, *b*, *b*, (see *Pl. III., Fig. 5, a*), by a sluice, *c*, to the supply trough, *d*, whence it is fed by a sluice, *e*, to the hatching-trough, *f*. *g*, wall of hatching-horse. *h*, cross-bar separating two squares. (See *Fig. 5, c*.)

FIG. 4.—Horizontal screen, to stop trout from passing up a fall.



Embryo of American Shad (*Alosa preestabilis*.)

B. Snodgrass, Lith. Harrisburg, Pa.

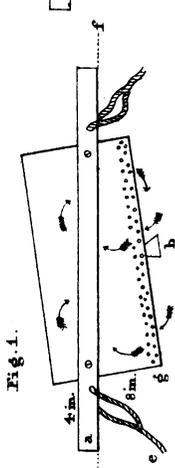


Fig. 1.

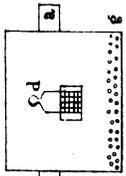


Fig. 2.

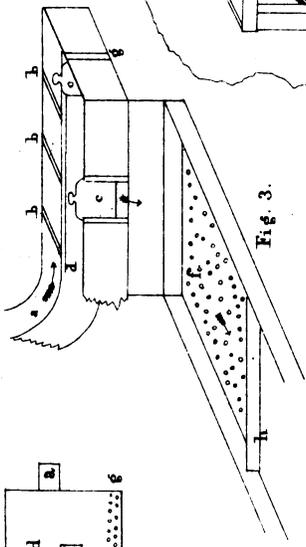


Fig. 3.

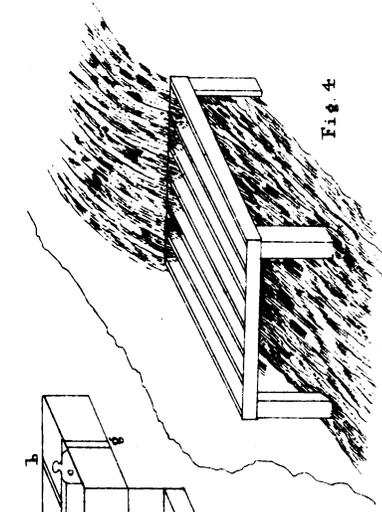


Fig. 4.

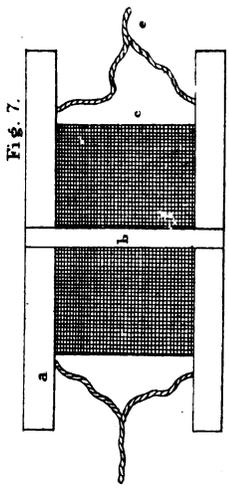


Fig. 7.

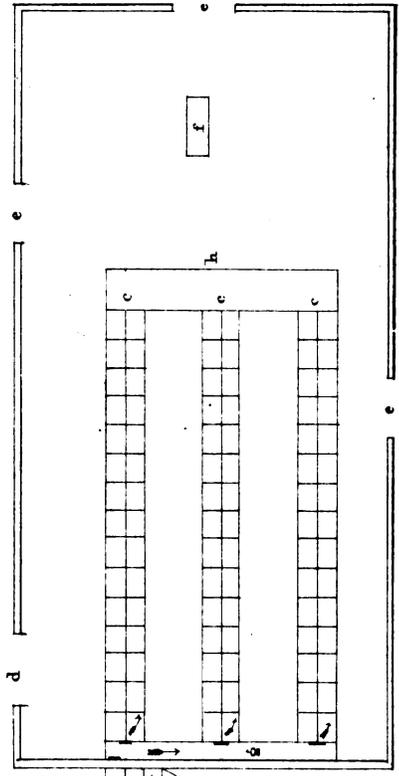


Fig. 5.

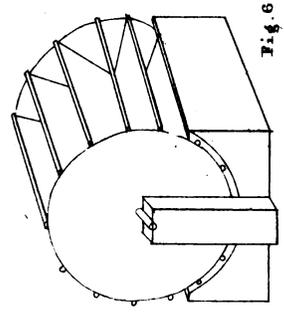


Fig. 6.

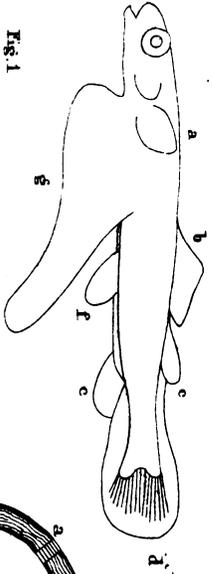


Fig. 1

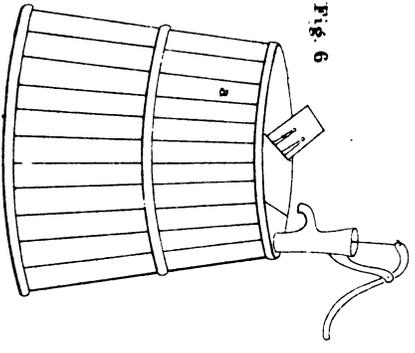


Fig. 6

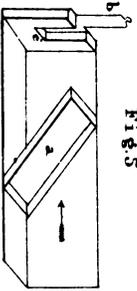


Fig. 5

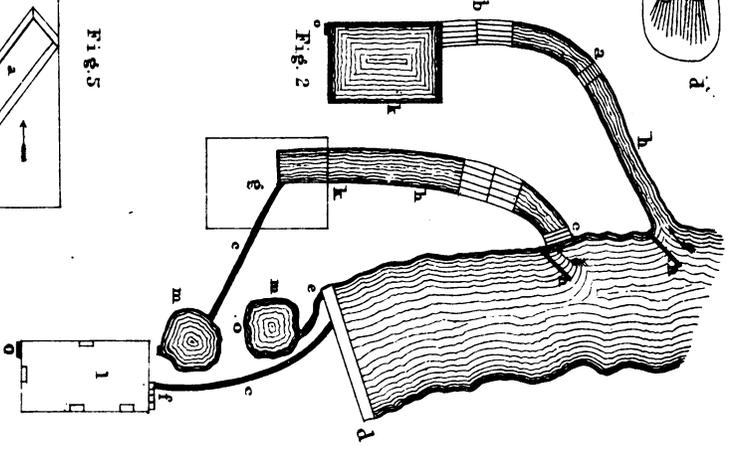


Fig. 2

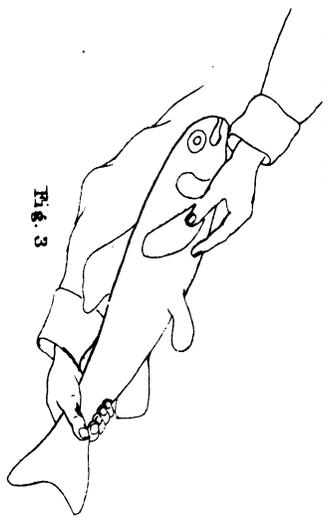


Fig. 3

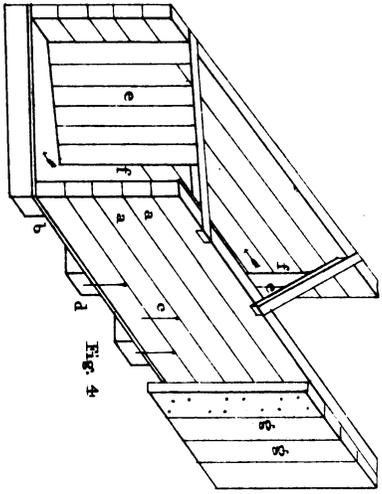


Fig. 4

FIG. 5.—Plan of a hatching-house. Scale, 1-120th. *a*, water conduit. *b*, strainers. *c*, hatching-troughs. *d*, door. *e, e*, windows. *f*, stove. *g*, supply trough. *h*, space cut out of floor for escape of water.

FIG. 6.—A current wheel, to stop fish from running up stream; while, like Fig. 4, it allows the passage of floating food.

PLATE III.

FIG. 1.—Young salmon just hatched (enlarged from Agassiz's *Poissons d'eau douce*, *Pl. 7, Fig. 170.*) *a*, pectoral fin. *b*, dorsal. *c*, adipose. *d*, caudal. *e*, anal. *f*, ventral. *g*, yolk-sac.

FIG. 2.—Trout ponds and breeding apparatus. *a*, grating. (*See Pl. II., Fig. 4.*) *b, b*, spawning beds. *c* current wheel. (*See Pl. II., Fig. 6.*) *d*, dam, to make a supply pond. *e, e, e*, water conduits. *f*, strainers. *g*, house. *h, h*, streams to fish pools. *k, k*, fish pools. *l*, hatching-house. *m, m*, pools for young. *n*, booms, to direct floating food to the ponds. *o, o*, outlets.

FIG. 3.—Position of fish in taking the spawn.

FIG. 4.—Section, to show details of Foster's fishway. *a, a*, side timbers, 4" by 7". *b*, plank floor. *c*, 10-inch spikes driven from timber to timber, and into the sill *d*, which is 5" by 6." *e, e*, bulk heads. *f, f*, openings for water. *g, g*, outer planking of two-inch plank nailed with six-inch spikes.*

FIG. 5.—Section of a trough, with a screen, *a*. *b*, gate. *c*, sluice-way.

FIG. 6.—Tank, to transport live fish, with a pump to aerate the water. Within, at the point *a*, may be a basket for ice.

The most important details, both in text and plates, about trout breeding, have been taken from the establishment of Seth Green.

*This is the approved fishway used on the smaller streams of the New England States. It is a simple trough, interrupted by panels or screens, with a partial opening, the effect of which is to form eddies in the down-flowing current. Its fall is 1-10. It is too slight a structure for such a river as the Susquehanna.

J. W.

[B.]

PHILADELPHIA, *December 21, 1868.*

TO COL. JAMES WORRELL:

DEAR SIR:—You say that I may be able to advance some views on restocking our declining and barren waters, which have not been presented to your own mind. I comply with your request to do so, as briefly as the importance of the subject will admit of.

In the matter of restoring the Susquehanna and its splendid tributaries to their former fruitfulness in herring and shad, I would first ask if the suit now pending against the Pennsylvania railroad is decided adversely. Is this gross injustice to be perpetuated, and the people of that large portion of our domain watered by that river and its upper waters, to be forever deprived of the great wealth of fish food, which is natural to it? It is to be hoped not. Then, why await such decision? The State Government, in violation of common justice to the citizens of the interior, has taken from them a valuable staple of life, in constructing internal improvements; and granted to companies and allowed individuals the power of doing the same. Should not the Legislature at once restore these rights by adequate appropriations to the end in view, and be reimbursed or not, as the issue of the suit in question, and the precedent it will establish, shall decide?

When the Schuylkill navigation company stopped the passage of shad and herring by their dams, the owner of a fishery, which brought him an income of six hundred dollars per annum, near the present town of Manayunk, sued the company for damages. At that time internal improvements were deservedly popular, and the continuance of migratory fishes, from their abundance, was not appreciated. Chief Justice Gibson, citing some old English law, or taking some old English decision where damages were done to a fishery (but where the case was not analogous to this) as precedent, decided against the plaintiff. The injustice done in this case has since been strongly condemned, and the decision criticized by some of our best legal minds. I regret that a friend who promised to furnish me with data by which I might refer you to the proper record of the case, has not done so in time for this letter.

The importance of the work you are engaged in is increasing every day. It is useless to dwell on the causes of decline in our fisheries; but I would ask, why legislate for the improvement of the Susquehanna alone? The Delaware also needs ameliorating, and in the entire restoration of both of these fine rivers, joint action with the States of New Jersey, Maryland and Delaware is needed.

In a recent conversation on this subject, you spoke of the destruction of the spawn of shad, between Columbia dam and Port Deposit from the ravages of eels and small fry. In tide water, where shad will also deposit their spawn, if debarred from ascending running streams, the destruction is also great from these causes; and much greater from the decay of the spawn. Because in *tide water* the necessary conditions to incubation are not furnished. Mr. Seth Green informs me that in the Potomac, below Washington, last spring, he collected great masses of decayed ova, and that such are also to be found at the head of the Chesapeake bay. It is plain then that to increase the number of shad and herring, the area of natural and suitable spawning grounds must be extended in the waters *above* tide. This can only be done by the construction of fish ways; and the more effectually by the co-operation of adjoining States. Our interests are mutual in this respect. So also should be our legislation.

The increase of the take in tide water will be dependent on the free passage of the fish to the upper waters, and laws regulating the manner and time of taking fish, as well as the length of the nets and sizes of their meshes, require revision, and subsequent strict enforcement. Thus in a combination of States, and people of the upper and lower parts of rivers, there is a community of interests that is inseparable. The expenditure of each State, as you must be aware, will be but slight, compared with the great increase and cheapening of palatable and nutritious food for our rapidly growing population. After proper fish-ways are constructed, the stocking of the upper waters, as you know, can be accomplished in the short space of two years, by means of artificial propagation. It would be but a small matter of skill or expense, to transport a hundred million of fecundated shad spawn from the lower to the upper waters of the Susquehanna. Twelve or fifteen hundred shad of each sex would furnish that number of eggs. The loss in the hatching of these eggs is but slight, as was evinced by the experiments at Holyoke, in 1866-7, when forty millions of young shad were hatched out each summer. We should, by all means, emulate the spirited example set by our New England neighbors in this respect, as well as in their liberality and enterprise in the construction of fish ways.

To restore the olden fecundity of the Delaware, and open the Susquehanna and Schuylkill to shad and herring once more, would be accomplishing much. But we should not rest when this was done.* Salmon, without doubt, may be naturalized in the Delaware, and perhaps in the Susquehanna. This noble fish acquires its rapid growth, great size and excellent flavor at sea; and like the shad ascends fresh rivers only to propagate its species. New York in a few years will restore salmon to the Hudson, and the Delaware is not more than a degree and a half south of it. The New England fish commissioners, as you see by their reports, are busy at work introducing salmon again into the rivers from which they have been banished by impassable dams. This is no chimerical scheme, or they would not have undertaken it.

You will observe in my work on fish culture, (p. 297,) mention made of an enterprise, entered into by Mr. Livingston Stone, of New Hampshire, in connection with the New England fish commissioners. This gentleman has established a salmon hatching establishment on the Miramichi, New Brunswick, with facilities for hatching a million of spawn. The eggs will be ready for transportation to the United States in about twenty days after they are taken. In a letter, which I have received from Mr. Stone, dated at his establishment, October 8th, he says:

"We have permission from the Canadian Government to take salmon at such times, at such places and by such means as we may find most convenient. This permission we avail ourselves of by setting a net entirely across the river and fishing every night except Saturday and Sunday night. As soon as a sufficient number of ova are matured, or ready for transportation, I shall make a trip home with them, which will be about the 10th of November. We have had a most violent prejudice to contend with amongst the fishermen and settlers here. They have caused us incalculable trouble and annoyance, but we are so protected now by the higher authorities that they can do us no more harm."

I think Mr. Stone's plan is to take the breeding fish as they come on the spawning ground, and confine them in a properly constructed enclosure in the river until they are quite ready to spawn. In a subsequent letter, dated October 13th, he says:

*I refer to the migratory salmon, not the pike perch of the Susquehanna, which bears the local but erroneous name of "salmon," and which is permanent in that river.

"I am happy to inform you that we are beginning to take salmon spawn very successfully. On the 15th we took eighty thousand from eight fish. On the 16th we took sixty thousand from five fish, some of which were twenty pounders. On the 17th we took eighty-one thousand five hundred from twelve fish, mostly small ones, and some partly spawned. We shall begin again on Monday, and by the end of the week expect to have our full complement."

If we keep up with the spirit of the age, my dear Colonel, in the matter of endeavoring to cheapen food for our millions, the day is not distant when we shall avail ourselves of these facilities, by purchasing salmon spawn of Mr. Stone, and trying, at least, an experimental hatching establishment on the Upper Delaware, or some of its tributaries. The spawn is as easily hatched in troughs of running water as the eggs of our brook trout; as has been demonstrated by Messrs. Stone and Robinson, of New Hampshire, for the New England fish commission. Ninety-nine per cent of the spawn that were fecundated were hatched, and there was but slight loss of the fry after they came out of the eggs. The third year after we set our salmon eggs to hatch, we could have grise, (*i. e.* half grown salmon,) and the next year adult salmon, from ten to fifteen pounds in weight, ascending our rivers from the sea.

As to the new industry of propagating and rearing trout for market, if I had not already written enough to weary you, I could adduce facts which have come under my observation since the publication of my little book on fish culture, which confirm me in my assertion that it can be made extremely profitable. The proprietor of one establishment which I was the means of starting in the fall of 1867, has already engaged to sell two thousand dollars worth of eggs and young fish this winter and next spring; besides starting his first brood of fifty thousand young fish for a succession of annual crops. The outlay of building his hatching house, apparatus and ponds, does not exceed a thousand dollars. Amongst the trout breeding operations which I am starting, there is one for Mr. R. H. Gratz, of this city, near Chestnut Hill, where we will hatch twenty-five or thirty thousand young fish to supply his ponds, which are to be built next summer. Mr. Gratz has gone into this project as a matter of sport, and as an ornament to his grounds. I hope in your next report you will recommend the enactment of some law which will unequivocally make trout in a man's pond on his premises, which he is rearing for use or sale, as much his property as his sheep or chickens. Also, that the Legislature revise and strengthen the laws against netting, and limit the time of taking trout in any way, to September 1st.

You inform me that some enterprising sportmen have stocked (though I think meagerly) the Susquehanna with black bass from the Potomac, and conveyed them in the same manner that those of the latter river were originally brought from the Ohio. A slight appropriation in discreet hands would accomplish much in a speedy stocking of all our streams with this fine fish, supplying food as well as sport. I hope there will be some law passed to protect these emigrants from the Potomac and their progeny, for at least five years.

I have exhausted your patience, I fear, so with hearty wishes for the success of the cause, which we, as well as all philanthropists and sportsmen feel so deep an interest in, I close by subscribing myself,

Yours most truly,

THADDEUS NORRIS.

[C.]

CONVENTION OF THE FISHERIES COMMISSIONERS.

In compliance with an invitation issued by the Board of Fisheries of this State, the commissioners which have been appointed by the various Northern States met at the Fifth Avenue hotel, in this city, on the evening of Tuesday, December 29, 1868. The meeting was well attended, and the utmost enthusiasm was displayed. Reports of it have subsequently appeared in the daily papers, and been heralded from one end of the land to the other; but, unfortunately, it was a new subject to the reporters: it was an intricate science, and experts were speaking a language known only to themselves. The whole thing was Greek to the gentlemen representing the press; in fact, worse than Greek, for their previous studies and education had made them far more familiar with the dead languages than with living fishes; and, to make matters worse, the experts in fish culture did not clearly appreciate the difficulties in the way of the experts of the press, and the time was not sufficient at the hurried conference, and in these fast days, to come to a mutual understanding. The result has been that some astonishing statements have found their way into the press.

The editors of our daily newspapers, however, make allowances for these little errors, and, bringing their vast experience and varied knowledge to bear on questions which are *omne ignotum* to the general public, usually arrive at correct conclusions. With remarkable unanimity the master spirits of the press have lent their assistance to the efforts of those interested in fish culture, and have encouraged the movement and spoken well of the conference. One or two of them had to indulge a little wit at the expense of the enthusiasts by reference to the "Cohasset clams" and "Massachusetts porgies," and their claims for protection; but, substantially, the brain power of the land has given its approval to an enterprise which we feel assured is destined to produce astounding results. In the following report of the meeting we shall be compelled to condense everything to the utmost possible extent, omitting all graces of language and expression, and giving merely a bald statement for practical future use and for the mere preservation of important information.

The following is a list of the commissioners of the States and the invited guests who were present as experts and counsellors:

Maine—Charles G. Atkins, Augusta; N. W. Foster, East Machias.

New Hampshire—Hon. H. A. Bellows, Concord; W. A. Sanborn, Weir's.

Vermont—Professor A. D. Hagar, Proctorsville; Hon. Charles Barrett, Grafton.

Massachusetts—Alfred R. Field, Greenfield; Theodore Lyman, Brookline.

Connecticut—H. Woodward, Middletown; James Rankin, Old Saybrook; James A. Bill, Lyme.

Rhode Island—Alfred A. Reed, Apponaug; Newton Dexter, Providence.

New York—Hon. Horatio Seymour, Utica; Seth Green, Mumford; Robert B. Roosevelt, New York.

Pennsylvania—James Worrall, Harrisburg.

Livingston Stone, of Charlestown, N. H.; Thaddeus Norris, of Philadelphia, Pa.; Benjamin P. Howell, of Woodbury, N. J.; W. A. Smith, of Brooklyn, N. Y.; Hon. Richard J. Haldeman, of Harrisburg, Pa.; Preston H. Hodges, of this city, and others who were interested in a private or public way in breeding fish.

Mr. Roosevelt called the meeting to order, and nominated Mr. Worrall, of Pennsylvania, as Chairman, and Mr. Lyman, of Massachusetts, as Secretary.

Mr. Worrall, on taking the chair, made the following report of the condition of fish culture and protection in his State:

The law under which I was appointed and the Fishery Commission of our State was created required that all persons owning or maintaining dams across the Susquehanna river should build fish passes in them. The lowest dam is at Columbia. It is six feet high. The fish way which I have had constructed there was an incline of one in fifteen. Three feet of the dam were cut away so as to obtain a good depth of water, and the consequent ascent was reduced to three feet, the fish way being forty-five feet long. The shad ascended it freely, obtaining access to spawning grounds above, from which they had been excluded totally, and the ensuing year twenty thousand of them were taken in a reach of fifty miles. The year following the catch was not so great, that being, as fishermen all know, a very bad season, the snow water running in until very late, and, we suppose driving the fish back. Above the Columbia are several private dams, the owners of which have refused to comply with the law, and the matter is now before the courts for adjudication. These dams shut out shad from a range of nearly three hundred miles, where they were formally abundant, coming up even into the State of New York through the numerous large branches of the Susquehanna. That stream has a coast line, counting both sides, of nearly a thousand miles. In old days it was so crowded with fish that the nets would be broken, and the question would be, not as to taking the fish, but as to obtaining sufficient salt to cure them. A barrel of fish was given for salt enough to cure another barrel, and shad were abundant at Towanda, two hundred and fifty miles above the mouth of the river. By the laws of my State the use of fish baskets is forbidden, but on the Maryland shore millions of shad fry are caught and destroyed in these baskets, at a terrible injury to the river and no profit to the fishermen.

The estuary of the Susquehanna is four or five miles long, a mile wide and sixteen feet deep. Every year this channel is crowded with shad in countless numbers, anxious, no doubt, to pass to the waters above. The Marylanders have seines one thousand four hundred yards long, with which they almost exterminate them. They also use drift nets, floating up and down with the tide over the entire distance. These gill nets are ruthlessly destructive, wounding vast quantities, which are subsequently eaten by eels. A gentleman of Port Deposit informed me he once saw a drift net hauled which had in it one hundred shad, and of these twenty-five were stripped bare to the skeleton by eels; there was actually nothing left of them but bones, and they were purely anatomical specimens. Between this estuary and the Columbia dam is a succession of rapids and pools, and to such a limited range of water the myriads of shad which once ascended the six hundred and fifty miles of the Susquehanna have been confined for many years, and until the fishway, of which I have spoken, was built two seasons ago. There is not one taken now where there were twenty taken formerly.

Mr. Norris then spoke as follows: It is generally conceded by those who have made pisciculture a study, that the increase of the supply of fish by the natural method depends entirely upon the extent to which the area of the spawning ground can be enlarged. The ova, when too crowded, will not thrive, and masses of shad spawn have been seen floating on the Susquehanna in a state of decomposition. The propagation of shad in Pennsylvania by the artificial method has not been attempted, and trout culture has been limited to a few private ponds, although the State abounds in natural trout streams. The greatest objection that has been offered to the construction of fishways has been the injury produced by cutting into the face of the dam; and I have had a model of a fishway which I have invented,

and which I hope, perhaps with the over confidence of an inventor, will remove the difficulty.

Mr. Howell then spoke for New Jersey: Until the year 1820 the fisheries in New Jersey were private property, and entirely shore fisheries, draw seines only being used. After that date drift nets were introduced. These take the fish at both tides, and it is supposed that shad invariably head against the current, as they are found in both sides of the nets. Below Trenton falls, the use of seines with a mesh which stretches more than three inches is prohibited after June 10, and after the 15th above. No fishing of any kind is allowed on Sunday, so that there is a weekly close time of one entire day. The mesh of the gill-nets cannot be less than four and a-half inches. These nets are now made from three hundred to five hundred rods long, and there are probably five hundred of them in use. In 1820 there were ten thousand eight hundred shad caught at one haul of the seine. From that time there has been a great falling off, and last year, from various causes, gave a very small yield. The seines are drawn three times only in a day, and are often interrupted by vessels. On two seines are employed seventy men, and the inhabitants of the shore depend upon this business largely for their sustenance. The seines take not merely shad, but herring, catfish and sturgeon; although the latter are mainly captured at present by the drift-nets prepared expressly for them.

Mr. Roosevelt then answered on behalf of New York: In order to ascertain the condition of the southern fisheries, and whether shad migrated in shoals along our coast from the south to the north, or merely passed the winter in the sea near the mouths of the rivers which they frequented, my colleague (Mr. Green) and myself visited the southern rivers. We found them greatly depleted, and heard loud complaints from the fishermen. They were fished by innumerable drift-nets, and the entire supply of shad bids fair soon to be exhausted, unless something was done to save it. But bad as was the condition of things at the south, it was much worse in the Hudson; there, actually there, could not be a sufficient number of breeders obtained to make artificial propagation an immediate success. In that river there are numberless stake nets in the lower part of the tideway; above, drift nets are used, while beyond them the seine is employed. There is no law limiting the time of fishing, or establishing a weekly close time, or restricting the size of the mesh; and the wonderful re-productive powers of the shad alone save our fisheries from total destruction. In relation to our fresh water fish, one suggestion that our commission has made, is that black bass, salmon, trout and whitefish should be introduced into all the numberless small ponds and inland lakes, which are at present inhabited by an inferior species. This could be carried to a vast extent with little expense or trouble, but care must be taken not to put black bass or perch into ponds inhabited by trout, as they will completely devour the spawn and fry of the latter. Formerly salmon reached the State of New York by the streams which empty into Lake Ontario, and a few will strive to surmount the dams and obstructions which have been placed in their way. No appropriation was made by our Legislature to build fish passes, and no authority in the matter was given to the New York commission. The first steps towards the propagation of whitefish have been taken, and probably by another year that will be in a condition for the Legislature to take action upon, but upon this subject my colleague can speak to you more fully.

Mr. Seth Green had brought with him a box containing the impregnated eggs of the trout and whitefish in all stages of development, and carefully packed in moss. He transferred one or two at a time to a homœopathic phial filled with water, where they could be readily examined. The fish in both

were plainly visible even without the magnifying glass, and their eyes were prominent, easily distinguished and jet black. Under the microscope the action of the heart could be seen, and in those furthest advanced the red blood was apparent rushing through the arteries. The ova of the whitefish were about one-tenth of the size of those of trout; the egg sack consisted of cells, which became reduced in number as the development advanced, being apparently absorbed by the growth of the fish. Mr. Green gave the following account of his experiments:

On the 11th day of May, 1868, I put four thousand shad spawn, properly impregnated, into a hatching box at Long Bridge, on the Potomac, the water being at a temperature of 64°. On the 13th they showed signs of life, and I put in seventy thousand more. On the 14th the form of the fish was visible, and on the 17th they hatched. To draw public interest to the matter, I hatched some in a tumbler in the house of General Spinner, at Washington. They left the egg eighty-four hours after impregnation, and hatched fifteen hundred in a salt box, with a sieve bottom, in a room in the treasury building. On the 13th day of May I had also obtained a quantity of white perch spawn. This is of a glutinous nature, and sticks fast to brush, weeds or grass, and can be readily transported in that condition. It hatched in about a week, with the temperature of the water at 62°. In the Potomac the striped bass and herring spawn May 25, the sturgeon May 20, and the catfish June 10. From that river I proceeded to the James, and continued my endeavors to interest the fishermen in propagating shad. Then I returned to New York, stopping on the Susquehanna and the Delaware, the latter a magnificent stream, where shad culture might be carried to any extent, and which might be filled with fish. On June 4 the fishermen were taking up their nets at Carmansville, and along the lower part of the Hudson, as they were only catching four or five fish a day. At Clifton I saw a shad with the spawn running from it. On the 18th I put a quantity of spawn into a box at James I. Mull's fishery, near Coeyman's ferry, and saw evidences of life in thirty-six hours with water at seventy-seven degrees. I had much trouble in getting spawners; they can be only taken at night. Both on the Hudson and Holyoke my experience was the same; during the day none were to be had; from 7 P. M. to 12 P. M. we could take them in proper condition, but after 12 P. M. we would only take unripe fish. This leads me to think they deposit their spawn during the day. The steamboats were troublesome, the waves that followed them washing over my boxes and carrying away the spawn. I had to locate my boxes behind the erections put in the river to deepen the channels. Very few shad are to be found above Albany; not one will be taken on an average at a haul, although there are several other kinds of fish more abundant; there must be an extremely small number that run the gauntlet below successfully. After I had thoroughly examined the Hudson, I proceeded to Holyoke, and continued the artificial propagation of shad until I was stopped by the hot weather. I instituted a series of experiments which conclusively proved that while shad will hatch with water at a temperature of seventy-eight degrees, the eggs will all die when the temperature rises to eighty-two degrees.

In the fall of this year (1868) I commenced the artificial culture of whitefish. I obtained a quantity of the spawn, and submitted it to various courses of treatment. My most successful plan was to manage it as I do the ova of trout—to put it in my hatching troughs, which are twenty-four feet long, with an inclination of three inches, and which are divided by bars across, two inches high. Gravel is laid in the compartments one and a half inches deep, so that the depth of water is only half of an inch. The eggs are heavy like those of trout, and sink instantly in water. In thirteen days

the fish were visible in the eggs by the aid of the microscope, and in twenty-one days they exhibited signs of life, the water standing at a temperature of forty-five degrees. They hatch more rapidly than trout, and in those which I have with me the fish is plainly visible to the naked eye. Most of these have been kept in wet moss, in which their development has progressed, although more slowly than when in their proper element. I only stripped five or six females, and obtained some two hundred thousand eggs, as they contain about ten thousand eggs to the pound of their weight. These were placed in damp moss as soon as impregnated, and carried in a buggy over our country roads seven miles, then by railroad twenty-five miles the same day. They are now doing well, and bid fair to hatch as large a percentage as could be expected with a first experiment.

Mr. Green's remarks were listened to with the deepest attention, and after he had closed Mr. Woodward explained the condition of affairs in Connecticut.

The supply of shad has greatly diminished in Connecticut, but we now have laws which will tend to their rapid restoration, when enforced in conjunction with artificial propagation. A weekly close time has been established, during which all fishing stops, and the pound nets have to be brailed up. This lasts from Saturday night until Monday morning, giving a clear thirty-six hours for the fish to pass up the streams. Formerly the pounds caught everything, the smallest shad and other fry being used for manure when unsaleable for other purposes. Now the mesh cannot be less than five inches, so that by these provisions, if we can have the co-operation of the State of New York, which has jurisdiction over the waters close to our shore, we hope to increase the number of shad materially. They are taken entirely to the westward of the mouth of the Connecticut river, never entering from the eastward, and are divided into three classes. No. 1 shad weigh from three and a half to seven pounds; No. 2, from two and a half to three and a half pounds; No. 3, from the size of a herring to two and a half pounds. No. 2 are called three cent shad, and everything smaller than No. 3 is called a herring shad, and either sold as a herring or used for manure. Formerly the law provided that thirty-six shad of No. 1 should constitute a hundred pounds; then the number was increased to forty, and now it really takes fifty to weigh one hundred pounds. The fishermen pretended that the size of the fish had diminished, and reduced the size of their mesh accordingly, whereas the fact was they were exhausting the fishery. We have tried introducing striped bass, which inhabit the Connecticut all the year through, into fresh water, and have imported a quantity of whitefish spawn; but the latter failed, probably in consequence of bad management.

Mr. Reed, of Rhode Island, stated that the streams of the State were so obstructed by dams and polluted by factories that it was almost impossible to introduce fish into them with any prospect of profit; but the sea fish—especially those which visited Narragansett bay—were numerous and valuable. These were being injured by the destruction of their food, the menhaden or mossbunker. The latter were taken for factories, which extracted the oil from them, and turned the refuse into manure. They were becoming exceedingly scarce, and measures would have to be taken to reconcile the interests of the factories with the rights of the fishermen. Many farmers were going into the breeding of trout in small streams, and oysters could be advantageously cultivated in the bay. There was only one river in the State where artificial propagation was feasible, that was the Pawcatuck, and there the attempt was to be made.

Mr. Lyman then responded for Massachusetts: He had brought with

him specimens of the land-locked salmon, or Schoodic trout. The question of fish culture in Massachusetts has become of great importance, and the State appropriated thirty thousand dollars last year for that purpose. Of this, over four thousand dollars was expended in the artificial hatching of shad. It should be known that the first experiments in shad culture, one year ago, have already shown signal success in the Connecticut river, as is proved by the fact that very many small shad were caught, the fishermen saying they were more plentiful than they should be. This increase was owing to the efforts of Seth Green, at Holyoke. Of salmon culture I can say that for two seasons salmon had been hatched in the Upper Merrimack, and now there were between four thousand and five thousand about a finger long, kept in confinement and ready to be turned out next spring. All the eggs came from New Brunswick. This season there was a far larger number being hatched. The black bass has been introduced, after repeated efforts, by Mr. Samuel B. Tisdale, into many small lakes. Lake trout and land-locked salmon are also to be introduced. Some thousands of eggs of the latter were now in the hatching house. It was also proposed to encourage the growth of such useful fishes as the smelt. Under the present laws of Massachusetts, any pond covering over ten acres was open to any fisherman, and I have proposed at the next session of the Legislature to have this law abolished, and also to recommend measures protecting all fish; and, further, that raised fish might be marked by their owners with silver wire, or otherwise; that in case of a fine for violation of laws relating to fish, one-half shall go to the complainant. I have always thought it questionable whether sea fish could possibly be diminished by any human fishing, and whether it was advisable to legislate upon it; but with fish that frequent the fresh water this is altogether different. The experiment last year at Double Ditch failed. It was a small affair, and merely an attempt to teach the fishermen themselves to hatch the shad. They were, probably, too rough in their treatment of the breeders, or did not understand when the spaw was ripe. There were only twelve boxes at Double Ditch, while at Hadley Falls, just above, Seth Green was at the same time running two hundred boxes with perfect success. The latter worked excellently until the sudden hot spell early in July, when the water of the river actually rose to eighty-eight degrees, and full grown fish, killed by the heat, were seen floating down with the current. This must have inflicted much injury, not merely upon the artificial, but upon the natural propagation, and may lead to a scarcity of fish next year. The water was in the same state at top and bottom, and all young fry which were exposed to such a temperature must have perished along with many of the mature fish.

Mr. Sanborn said that for some time there was no adequate law in New Hampshire relating to the taking of trout out of season; but the statute was amended so that the possession of this fish was considered as *prima facie* evidence. This year more trout have, consequently, been taken from Lake Winnepiseogee than for several years before. Some efforts have recently been made to introduce black bass and lake trout, and also by some gentlemen to raise brook trout.

Mr. Stone then gave an account of his efforts to procure salmon spawn from Canada, and of his experiments in raising the fish for introduction into the United States. He said it was difficult to get salmon spawn in New Brunswick, owing to the violent prejudice prevailing there against any such proceeding, and last year we had our nets torn up and the salmon turned loose, and were obliged to pay fines amounting to about \$100 in gold. We received verbal permission from the Minister of Marine, but the local authorities seized eight of our nets because we had no written authority.

In consequence of these delays we only obtained forty-seven spawning salmon, and could only bring to the United States about 230,000 salmon ova, one-half of the fry being claimed by the Canadian government for the good of the river. We obtained the breeders by stretching a gaspereau net entirely across the river in the shape of a V, with a pound in the middle. The first night the fish would come up and examine it, but none would pass. The next night we would find some in the pound; thence they would pass into a creel connected with it. This would then be towed down the river to the breeding establishment, and floated into a small pond. The hatching house is one hundred feet long, and will hatch a million of salmon yearly. In the pool the fish came up freely to the spawning bed until we placed a roof over it, then they became alarmed, and we had to remove it. There will be no trouble in the future, as a permit has been obtained to take three hundred fish, provided one-half of the fry hatched are returned to the river. The salmon were not injured, apparently, in the operation of extracting the ova, and the latter are doing well. Some of the breeders lived two months in the pond without any food whatever, and yet their spawn hatched—a fact which shows that salmon can go entirely without food while in the fresh water, and not suffer the slightest injury.

On motion of Mr. Lyman, a committee, consisting of the chairman and Mr. Roosevelt, was appointed to prepare resolutions.

The following letters were then read:

WEST BLOOMFIELD, N. Y., Dec. 24, 1868.

ROBERT B. ROOSEVELT, Esq.:

DEAR SIR:—Yours of the 21st, asking me to meet with the Commissioners of Fisheries of the various States for consultation, at the Fifth Avenue hotel, on the 29th inst., at 8 o'clock, P. M., &c., was received last evening.

I thank you for the confidence in my ability to aid you in your discussions expressed in your letter, as well as for the invitation to meet with you.

I would attend with pleasure, if I thought I could assist you in the least in the great enterprise of re-stocking our depleted waters with fish.

My main study has been to bring the artificial propagation of brook trout to perfection—to hatch all the spawn, and to grow all the young fry without loss. I hope we have the key to both, and that in time we shall be able to take all the spawn of all varieties of fish, when fully ripe, so as to impregnate all, hatch all, and grow all. When this is accomplished, the re-stocking of our rivers, lakes and ponds will be comparatively easy, provided the States—or, better, the United States—will provide the funds, and pass necessary laws to protect them, with proper reciprocity laws with Canada. I have not studied the best plans for opening our rivers to the passage of fish, as I have had nothing to do practically in that direction; but I have no doubt that this can be easily done, so as to insure the passage of all fish up to the proper temperature of the water to hatch their ova, or to the spawning beds where the parent fish were hatched or placed.

Should I attend, it would be to learn, not to instruct.

Your board is composed of the first minds of our nation, all understanding the theoretical parts of these subjects fully, and some of you the practical parts, in all their bearings, so that you have all the desired information in your own minds, without outside assistance, to decide upon the best possible plans to pursue hereafter.

I will try to be present to hear your learned discussions, and profit by them.

Respectfully yours,
STEPHEN H. AINSWORTH.

EAST MACHIAS, Dec. 22, 1868.

GENTLEMEN:—Your note extending to me an invitation to unite with you in the convention to be held in the city of New York on the 29th inst., has been received. It would give me great pleasure to be present on that important occasion, and again meet with my old friends and fellow-commissioners; but embarrassments from protracted sickness will prevent me from going so long a distance. Though I am not able to be present personally, my heart will be with you in this noble enterprise, and I trust you will have a convention worthy of the occasion.

Gentlemen, it would give me great satisfaction to contribute something to this noble work. Permit me to offer for the good of the public some of my practical experience in the construction of fishways for the last twenty years. After many experiments, I find the best built on an inclined plane of one foot in ten, say from six feet to twelve in width, as the locality will permit, and from three or four feet deep—four feet at the upper end, and three at the lower—that the fish ascending may find the water deepening, with bulkheads placed at an angle of thirty degrees from the side line of the fishway, the passage from one apartment to the other to be two feet at the bottom and one at the top; if for shad only, give a space of one foot wider, as they are more timid in shoal water than are salmon or alewives. Much depends on the locality of a fishway for success in the free entrance of fish into the fishway. Where it is practicable I find it best to make a return towards the dam, as the fish invariably play up to the dam. I would recommend that alewives be introduced into rivers where shad are to be cultivated, as they migrate about the same time, and the alewives will enter a fishway sooner than shad, and these shoaling together, the shad will follow. For shad the fishways should not be covered. A fishway for salmon and alewives need not be over eight feet wide. At the mouth of the fishway a pool should be dug three or four feet below the bed of the river, and a good quantity of smooth pebble stones and coarse gravel put in the bottom of the pool, as the salmon is often found in such natural pools in salmon rivers. I once helped to sweep six barrels of salmon out of one of these natural resting-places in a few hours.

I accompanied Commissioner Atkins to Grand Lake Stream on the St. Croix river, for the purpose of procuring the land-locked salmon spawn, of which we obtained from fifteen to twenty thousand, and placed them in sieves in a prepared spring, where they remained until well developed for transportation. We had to take many of the fish from the Indians after being speared, a practice I utterly condemn. Nets can be so constructed and placed in the river as to take salmon or trout without injury; and, if not ripe, place them in ponds or tanks until they are ready and ripe for spawning. These nets may be used to great advantage for taking spawning fish, and none need be killed.

Enclosed is a photographic view of the model of a fishway for the dam at Yolyoke, on the Connecticut river. I have forwarded by mail one of our first reports, and have penciled a reference to the plate of a fishway on page 78. (*Pl. II, fig. 4.*)

With much respect,

N. W. FOSTER,

The models of fish ladders sent by Mr. Frank Buckland, the British Inspector of Salmon Fisheries, to the New York Commissioners of Fisheries, were then produced and examined. They were models of fish ladders which were in actual successful application in England, and were examined with much interest by the gentlemen present. They represented the pool sys-

tem, which is probably the best for salmon, and various other arrangements which are difficult to describe on paper. This matter, being one which had been but little considered heretofore in this country, was of vast importance. Although the great height of many of our dams and the immense volume of water which passes over them may require certain modifications in the structure of the plans presented. It may possibly be that shad and salmon may require different kinds of fishways, and that the question of arranging one to answer for both may still be left for Americans to solve. On this subject the following letter from Mr. Frank Buckland was read:

SALMON FISHERIES OFFICE, 4 OLD PALACE YARD,
WESTMINSTER, S. W., June 1, 1868.)

DEAR SIR:—Apologies for not having answered your note before. I have in my museum of "Economic-Fish Culture" (Royal Horticultural Gardens) several models of salmon ladders, hardly any two alike. I will see what it will cost to have drawings made of them. In the meantime, I think the best plan you can adopt is a board across to concentrate the water. It should be fixed with iron pins on the face of the weir, and, if found to answer, should be made permanent in stone. Mind the board must always end over the pool, where the fish assemble.

You may often get fish over weirs by building pools at the sides of sloping weirs with stones or timber. A notch should be made in each partition to let the water through.

The pool system is applicable to most small weirs. The fish cannot jump six feet, therefore, make an obstruction four feet high in the wasteway, when the water at once fills up and makes a pool, and the fish has then only two feet to jump; make a second obstruction below, which shall be two feet high; another below that again, one and a half feet high. The fish jumps into each pool, and then over. This may be placed in the middle of a perpendicular weir, only turned sideways to it like a pair of library steps, but this has not as yet been tried.

The pool system is, in my idea, always preferable to the old ladder system. Another good plan may be to heighten the water on the top of the weir by means of a board, and thus make it go down a pass constructed for its reception.

Do you ever see my journal, *Land and Water*, 80 Fleet street? I send you the last few copies, and shall be pleased to make it of any service to yourself and brother connoisseurs, to whom present my compliments.

Please command me at any time.

Yours, obediently,

FRANK BUCKLAND.

The committee which had been appointed to prepare resolutions then reported the following, which were adopted, and the convention adjourned, subject to the call of the chairman and secretary:

WHEREAS, Both the marine and inland fisheries of the Atlantic States have much deteriorated, and a vast source of supply of food for the people has been greatly injured, by causes entirely within the control of legislation:

And whereas, The present yield of fish from the salt and fresh waters could be largely increased by simple measures of protection and propagation.

Resolved, That every effort should be made, not only in the States represented in this convention, but in all those which border on the Atlantic ocean, to draw legislative attention to the subject, and effect such modifica-

tions of old laws and enactments of new ones as will conduce to the restoration, development and protection of the public fisheries.

That the subject is of vast importance to the people, and should by every means possible be placed before them in its true light, in order that they may understand fully the benefit which may be obtained by the community by proper care of this valuable branch of the public natural resources.

That laws in adjacent States should be concurrent and uniform, in order that there may be no conflict between the owners of different parts of a stream or coast, and that the same object may be kept in view by all.

That fish culture, both by the artificial impregnation of the *ova* and by the modification of obstructions which have reduced the natural area of the spawning grounds of the fish, although as yet comparatively in its infancy, has yielded most satisfactory results, and will furnish valuable assistance in stocking or replenishing public waters.

That the true interests of the fishermen accord absolutely with the advantage of the public, and that legislation should not be hostile to them, but tend to develop this conformity, improve the fisheries and benefit the public.

(Signed) JAMES WORRALL, of Penn'a,

President.

THEODORE LYMAN, of Mass.,

Secretary.

ERRATA.

Page 8, sixth line from top, for "Clerrfield," read "Clearfield."

Page 10, fourteenth line from top, for "re-habiting," read "re-habilitating."

Page 11, third line from top, for "r-efill," read "re-fill."

Page 12, eighteenth line from bottom, for "the hands," read "their hand."

Page 28, seventh line from bottom, for "accomblish," read "accomplish."

Page 36, eighth line from bottom, for "Plate II, figure 4," read "Plate III, figure 4."

Page 36, tenth line from bottom, for "Yolyoke," read "Holyoke."

In Plate I, figure 4, supply reference letter c at mouth of fish.

of rare

J. J. Thomas
with respects of Col. Morris

Commonwealth of Pennsylvania.

REPORT

OF THE

Commissioner for the Restoration

OF THE

INLAND FISHERIES,

For the year 1870.

HARRISBURG:
B. SINGERLY, STATE PRINTER.
1871.

COMMONWEALTH OF PENNSYLVANIA,

REPORT

OF THE

COMMISSIONER FOR THE RESTORATION

OF THE

INLAND FISHERIES,

FOR THE YEAR 1870.

HARRISBURG:
B. SINGERLY, STATE PRINTER
1871.

REPORT.

HARRISBURG, *January 23, 1871*

To his Excellency JOHN W. GEARY,
Governor of Pennsylvania :

SIR:—In reporting upon the restoration of the inland fisheries, I will recapitulate, briefly, to save the trouble of reference to former documents, glancing at the history of the movement in the United States.

Of late years a manifest deterioration had been observed along our whole northern coast of the fisheries, which had heretofore furnished such a bountiful and apparently inexhaustible supply of edible migratory or anadromous fishes to the people of the region, and the minds of public spirited men were directed toward some means of remedying this evil. On examining into the subject they found that in the British islands and on the continent of Europe the same had been observed and remedies applied. In France the government had taken the subject up, and established a department having it in charge. In England, Ireland and Scotland also, measures had been adopted to arrest the decay of this vast source of food supply, and artificial means and proper laws had been established with most beneficial results.

In 1865 Massachusetts appointed commissioners to inquire into the subject, and the result was that a law was passed requiring fish-ways to be made in the impeding dams, and a code of laws established for the regulation of the fisheries.

In 1866 a convention met in Harrisburg to consider the state of things in Pennsylvania, and a law was prepared with care, under the supervision of men of first rate legal reputation, which law was promptly passed by the Legislature then in session, receiving the signature of the Governor on the 30th day of March, 1866.

This law was based on the Massachusetts enactment, and required that fish ways should be constructed in all the dams of the Susquehanna and its tributaries.

The first impeding dam on the Susquehanna was the Columbia dam, the Safe Harbor dam, a short distance below, having been then recently carried away by a freshet, and not re-built, the Columbia dam belonging to the Tide Water canal company, which company was bound to keep an open passage for fish, in its dam. Accordingly, when required by the Commissioner appointed by the Governor, the Tide Water canal company, without hesitation, and at an expense to itself of some five thousand dollars, created the opening.

The corporations, however, owning the next dams above, having purchased those works without incumbrance from the State, demurred to the

law as unconstitutional, and refused or neglected to comply with its provisions.

Suit was instituted by the State authorities against these corporations, in the court of quarter sessions of Dauphin county, and it was there decided that the companies were not compelled, at their own expense, to make these openings. The case was then carried to the Supreme Court, and the opinion of the court below was affirmed by that tribunal.

These proceedings were not closed until the spring session of 1870, of the Supreme Court, at Harrisburg.

The legal proceedings were initiated in strict obedience to the letter of the law.

There is no use in attempting to account for the laws delay. We are now, however, at the end; for, I take it, there is no way for the State to reach a higher court—though if the case had gone against the corporations, they could have appealed to the courts of the United States. I mention this, for judicial decision has taken a different direction in Massachusetts. There, as I understand, it has been decided in the Supreme Court that the owners of dams are liable to open the dams at their own expense—and the corporations have appealed to the Federal courts.

There is some technical difference, no doubt, in the manner in which rights in the dams became vested in private parties, in Pennsylvania and in Massachusetts. There is no difference in the original setting aside of the people's right of fishing by the construction of the dams, in either case. In Massachusetts, the people do not have to pay for the laches of their former servants. In Pennsylvania, it seems they do; for I cannot perceive that the State may not make the openings in the dams, provided she pays for them. [See Appendix.]

The result of the opening at Columbia, for the first two years, appeared to be a complete success. The year 1867, showed a catch, reported from fifteen to twenty thousand in number, above that dam. In 1868, the catch was perhaps half that number, whilst in 1869 and 1870, the catch has probably not exceeded five thousand in each year.

Probably because even the highest number caught scattered over a distance of fifty miles was no temptation for the number of hands required to manage large seines; and because, also, it was too expensive to clean out the old fishing grounds for seining; and because the kind of seines necessary for shad fishing, on anything like a profitable scale, were too expensive, the inducements are insufficient for fishing in the fifty mile reach above the Columbia dam at present. Unless the shad return in large numbers to the river, fishing on the proper scale is not likely to be prosecuted.

Although the Legislature was not slow in enacting sufficiently stringent laws, and which could be enforced with perfect ease, the fishing in the neighborhood of the Columbia dam has been practiced in defiance of them.

In the statute April 9, 1868, it is enacted, that, it shall not be "lawful to fish with any seine or by any other system of entrapping in numbers within two hundred yards of any sluice or other device, erected for the passage of fish as described in this act, or upon or about any dam in or upon which such sluice shall have been erected," &c., &c.—*Pamphlet Laws 1868, p. 78.* Yet regularly as the spring comes round, there are dip nets worked by sweeps, like well sweeps, at every few rods; kept in operation perpetually during the whole twenty-four hours in front of the Columbia dam, rising out of and falling into the reacting water of the dam as it falls over its face.

These dip nets are used for catching mullets, their very operation precluding the possibility of catching shad in them, for their intermittent motion has a tendency, nay is absolutely certain to scare away those timid fish from the face of the dam.

Ten or a dozen such machines working night and day, in a row, in front of the dam and in its reaction water, at distances not more than six or eight rods apart, effectually stop the approach of the fish to the dam, to seek a means of passing through it. It is well known that the shad upon reaching the dam nose along in front of it, in the reaction, seeking some opposing current against which it is their instinct to propel themselves. But interrupted as they are by this constant rising and falling of these great dip nets, ten or twelve feet square, the timid fish are baffled and driven away. Is not this system of dip netting a fishing "upon or about" the dam, etc.? Yet yearly they make their appearance, and operate in sight of the people with perfect impunity, any individual of whom might prosecute the owners to conviction and to the payment of the penalty, if he were so minded. Notwithstanding this, however, and although the catch above the dam is small, many shad make their way through this opening yearly. For yearly as the autumn comes round, vast numbers of small fry are seen descending the river from waters above the Columbia dam. These little creatures, however, are not exempt from unlawful, piratical fishing. Hundreds of thousands of them are destroyed yearly in the vile fish baskets, which no law that the Legislature can pass seems capable of abolishing.

Our ancestors in England put an end to this shameful system of destroying fish over six hundred years ago. Their abolishment is even provided for in Magna Charta.*

In Hepworth Dixon's interesting sketches relating to "Her Majesty's Tower," (The tower of London,) I find the following :

"One of the King's officers, the Tower Warden, was a man with extensive powers and a hundred archers at his back. A subject always in dispute between this officer and the city folk, was a claim put forth by him to catch fish in what the commons called an unfair way. The warden claimed a right to put kidels in the water, not only in front of the wharf, but in any other part of the stream. Now a kidel was a weir (or wear) filled up with nets which caught all fish coming down with the tide, both the small fry and the old flappers. What free angler could stand this claim? Through five or six reigns our fathers fought against this abuse, and the question of a warden's right to put kidels in the Thames was a topic which roused the water-side folk into fiercer passion than reports of fighting in Picardy and pilgrimage in the Holy Land.

"A kidel in front of the wharf was an outrage as well as an injury. Our fathers loved the rod and line. Hundreds of years before Izaack quaffed the village ale, and listened to the milkmaid's song, his foregoers had been wont to cast their lines into the Lea, the Wandle and the Thames. Nor was the gentle craft pursued by them in sport alone; fish was an article of food; the fisheries on the Thames being large enough to employ, and rich enough to feed a tenth of the population on its banks; and to all these pleasures and profits, the right of a Tower Warden to net the stream with kidels

*Clause 36 according to Rowland ("Manual of the English Constitution") or according to Creasy, (on English constitutional law,) clause 33 of Magna Charta reads thus: "All wears for the time to come shall be demolished in the rivers Thames and Medway, and throughout all England, except upon the sea coast." And in a note Creasy says: "The peculiar kind of wear mentioned in the Latin text, and called *Kidelli*, were dams having a narrow cut in them, and furnished with devices for catching fish." Precisely the fish basket of the present day. He also says: "It was the opinion of Lord Coke that no part of a stream being the King's highway could be appropriated by any private individual." A legal friend has kindly furnished me the original from Blackstone's Law Tracts, vol. 2, p. 24:

"SECTION 33. Omnes Kydelli de cetero deponantur penitus de Thamisia et de Medewaye et per to tam Angliam nisi per cofteram maris."

was a serious bar. The water-side taverns were up in arms when these water-side taverns were the meeting houses of all our turbulent and daring spirits. They had indeed good reason for their wrath, since the King's warden, not content with setting his own kidels in the Thames, rented to others his privilege of interfering with honest sport and decent trade. For a small sum of money any rascal on the river could buy his license and set up kidels in the Lea and Medway as well as in the Thames. The effect of netting those rivers was to destroy the salmon and shad, as well as to capture the flounders and the trout.

"Now and then a prince, in his distress, consented to forego this river right; but his warden took scant notice of a pledge which he thought injurious to his pocket and derogatory to his prince.

"Lion Heart (Richard Cœur de Lion) strove to bring this quarrel to an end, and in the eighth year of his reign, in the press of a sharp war, he made what he said was a high sacrifice in giving up kidels, and putting his warden of the tower on a level with humbler and fairer folk. For this surrender Lion Heart expected to be paid, not only in earthly coin, but in heavenly grace. In the grant by which he gave the public their own, he declared that for the salvation of his soul, for the salvation of his father's soul, and for the salvation of the souls of all his ancestors, as well as for the benefit of his people and the peace of his realm, no more kidels should be set up in the Thames.

"But Lion Heart failed to keep his pledge. The warden was always nigh; the king was often far away; and the kidel question helped to keep alive the long resistance to King John.

"In the great charter there was a special clause on kidels, King John consenting, among other things, that under pain of excommunication all kidels should be removed from the Thames, and from his other streams. Yet the warden, paying scant attention to a parchment which he probably could not read, laid down his weirs and nets as before, only desisting for a time, when the sheriff of London, backed by an armed band, dropped down the river and seized (or demolished) his nets (or weirs.)

"One fight was made by the London folk, in the reign of Henry III, in behalf of sport and trade, which became famous in city story, and got a niche in every old chronicle, and in many a popular song.

"Complaints were made before Andrew Buckrell, mayor, Henry de Cotham, sheriff, and other magistrates, that many new kidels had been laid in the Thames and Medway, by authority of the tower warden, contrary to the city franchises, and to the great injury of the common people.

"More than elsewhere, this wrong was being done to them in the neighborhood of Yantlett creek.

"This was a ticklish thing; for, although the Thames lay under the jurisdiction of London, for many purposes, it was not clear that the mayor and a city band had any right to pursue offenders up the Medway, and seize them under the walls of Rochester castle. They put their right to the test. Jordan de Coventry, second sheriff, with a body of men well armed and resolute, started on the 6th of January, 1236-7, for Yantlett creek, where they fell suddenly and stoutly on the master fishermen and their servants. They found no less than thirty kidels, beyond that creek, towards the sea. With little ado, they tore up the nets and seized the masters. Joscelyn, and four good men of Rochester; seven good men of Strood; three good men of Cliff, all master mariners, with nine others, their helpers and abettors in wrong.

"Jordan brought these captured nets and culprits up to London, where

he gave the nets to the first sheriff, and lodged the master mariners in Newgate.

"When the news of this raid reached Rochester, Strood and Cliff, much din arose, and men from these towns rode up to London, to see what could be done for Joscelyn and his fellows. They applied to the King for help, on the ground that no man had power to seize the King's subjects by force, and cast them into jail, without his license. Henry inclined to take this view, but the mayor and sheriffs maintained their right to arrest offenders against the King's laws and city franchises. Being then absent from London, Henry sent a writ to the mayor, commanding him to accept bail for the appearance of his prisoners, until such time as the King could hold a court to try the case.

"This court was called in the Palace of Kennington; when Buckrell and the citizens, Joscelyn and the master mariners, appeared before the Archbishop of York, the Lord Chancellor and other great personages, among whom, the most eminent, was William de Raleigh, the famous justiciar, a collateral ancestor of Sir Walter.

"William de Raleigh, who held a brief, as it were, for the crown, put Buckrell and his men on their mettle. 'How,' he asked them, 'had they with such rash daring seized the King's liegemen in their boats and cast them into a common jail?' Buckrell answered him, 'that he had seized Joscelyn and the rest for just reasons, because being taken in the act of using kidels, (fish baskets,) they were infringing the rights of the city, lessening the dignity of the crown, and incurring the ban of excommunication in accordance with the express clause of the Great Charter. He asked, in conclusion, that the judges should enforce the law and punish the master mariners by a heavy fine.

"William de Raleigh took this view of the kidel business, and his verdict gave immense delight at Guildhall. He sentenced Joscelyn and the other masters to pay a fine of ten pounds each, the fines to be rendered to the chief men of the city.

"A great fire was lighted in West Cheape, and the captured nets from Yantlett creek were burned in the presence of a joyful crowd."

Thus six hundred years ago it will be seen that our English ancestors, the Saxon Churls, as they were called, rid themselves of these wretched devices, whilst our rivers are filled with them to this day.

In some few instances, suits have been brought against these unlawful traps, but, although the law is as plain and simple as language can make it, as yet there have been no convictions. Error in the mode of bringing suit seems to be the difficulty. The law is on the statute book, however, unrepealed, and it is to be hoped that punishment will yet reach the offenders.

I have no hesitation in saying that these fish baskets have tended more to the diminution of our fish supply than the dams themselves. The dams have, all of them, (on the main streams,) sluiceways for navigation cut through them, and it is certain that these have always permitted a small proportion of the yearly return of shad to ascend the river every spring. But the fish baskets have regularly destroyed the fry produced by the spawning of these more vigorous fish as fast almost as they came to life. Bushels of the murdered fry have clogged the fish baskets, and have to be shovelled away like dead leaves, year after year, ever since the dams have been built, and thus the fish, endeavoring even to accommodate themselves to the new and more difficult means of ascension, have been frustrated and their progeny destroyed.

It is well known that the returning shad will make almost preternatural efforts to reach the grounds on which they were spawned, there to deposit

their spawn in turn. But if the fry produced from this spawn be gratuitously destroyed, of what avail is the powerful instinct of the fish?

It is not only the shad that are reduced in number by this unfair and murderous system—all are fish that come to these nets. Every fish not thinner than, say half an inch, of what species soever, is caught in these meshes, to die and be shovelled out like so much dung into the stream.

The truth is that our fisheries have never been regulated by law. Laws have been passed but they have not been enforced. There must be a remedy for this which must be speedily sought out and put in practice.

Below the Columbia dam the system of fish basket or kiddie fishing (I adopt Webster's orthography) is carried to as great if not a greater extent. The river, for miles and miles, is studded with innumerable rocks, in every form of grouping. Many of these rocks occur in twins, with a small space between them, through which the water rushes, and there is no case of the kind which has been neglected by the kiddlers. Between these twin rocks a fish basket is certain to be found. Now, the law is, even at this moment, sufficient for their total extinction. It only requires that the people should act with a determination that they shall be ended. Nay, if the constables will simply do the duty prescribed for them by law they can be stopped.

If the grand juries would present a few of these constables for non-performance of their duties—if the judges would draw the attention of the grand juries to the subject, they can be abolished. But if the people, the constables, the grand juries and the judges all lie upon their backs, asleep in respect to these breaches of the law, do we not deserve to be deprived of our fish?

We want this reform in Pennsylvania not only for the shad. All the other fish of the Susquehanna and the Delaware would immediately increase in numbers.

Recently some enterprising private individuals have introduced the black bass into our stream, (the main Susquehanna.) These ought to be allowed some chance to increase in numbers. The Upper Potomac is full of these delightful table fish, all produced from a few thrown into the stream by a locomotive engine driver at Cumberland, who brought them in his tank from the Monongahela. The fishing in the Potomac was incidentally protected by the war—that river forming a line between the belligerents. For several years it was unsafe for individuals to appear on either of its banks. Hence there was little or no fishing on any thing like a large scale, and as for fish baskets they naturally fell into decay and disuse. The result is that the Upper Potomac teems with these excellent fish, a fish that can be taken with the hook and line even when they have reached the weight of ten and twelve pounds. If protected from this destructive system of fishing we shall have them as plentiful in the Susquehanna in a very few years. Already their progeny have become the prey of the fish baskets, however. Buckets-ful have been caught in them in the Juniata and the Susquehanna, and small boys, gamins, have filled their pockets with them and taken them home as a new fish, recently appearing in our waters, to ask pap: "Where could they have come from?" This will interest the gentlemen who paid a dollar a piece to introduce their parents alive into the river. Yet the law is sound and full. Whose fault is it if it be not observed? It is everybody's business, yet nobody's business. But everybody must watch, and inform and bring to punishment the infractors of the law or there will be no increase of fish. Our magnificent Susquehanna salmon, as it is improperly called, (belonging as it does to the perch genus,) has lately been observed to be on the increase. Why? Because, in the reach between Colum

bia and Duncan's island, many fish baskets have been, in contemplation of the law, allowed to decay. But the progeny of these are caught by the bucket-ful and used for *bait* on our upper reaches. Thus the increase is kept down by the same cause that annihilates the other tribes.

But the shad fisheries below Columbia have deteriorated very much in the last thirty years. There are not five caught now where there were a hundred in the earlier day. This is because the numbers that reach the upper spawning grounds have been reduced by the obstacles occasioned by the dams and by fish baskets.*

Maryland is riparian to both banks of the Susquehanna for about fifteen miles above its mouth, and the laws of Maryland require revision as well as our own.

It has been the prescribed duty of your Commissioner to endeavor to obtain concurrent legislation with Maryland. At the bi-ennial session of the Legislature of Maryland of 1870 he proceeded to Annapolis, and found that the subject was beginning to attract attention, the Governor (Governor Bowie) having recommended the appointment of commissioners for that State.

The Commissioner of Pennsylvania, joined by one of those from New York, (Hon. Robert B. Roosevelt,) secured the recommendations of the Governor of Maryland, and about the end of the session a law was passed, providing for the appointment of Commissioners. This law creates parties with whom to treat in the State of Maryland. Those Commissioners are required to report legislation to the General Assembly of Maryland, at its next meeting, which meeting, the sessions being bi-ennial, will not occur until January, 1872. By that time it is to be hoped that an understanding can be come to between the authorities of the two States, which carried out, will result in benefit common to both.

Concurrent legislation with New Jersey and Delaware, on the subject of the fisheries of the Delaware river, both those States being riparian to that stream, is also called for, and the subject has not been neglected. Your Commissioner proceeded to Trenton, during the session of the New Jersey Legislature of 1870, and, representing the necessity of some mutual understanding between the States, recommended the appointment of commissioners to take the subject in hand. He was aided in his representations by prominent citizens of New Jersey, interested in the fisheries, and by others anxious to place New Jersey square with the advancement of the New England and her sister middle States, in this very important material interest. The Legislature, near the day of its adjournment, passed a law for the creation of a commission, and Dr. Benjamin P. Howell, of Woodbury, and Dr. John H. Slack, of Bloomsbury, New Jersey, were soon after appointed by the Governor of that State (Governor Randolph) Commissioners of Fisheries.

In the full run of the shad season the commissioners of New Jersey and Pennsylvania met on the Delaware, visiting the tide water fisheries between Salem and Philadelphia, and gave their best attention to the very important subject before them.

A subsequent convention of the same commissioners met in New Jersey in November, and visited the Delaware river above the tide water, say from Trenton to Easton, carefully examining the obstructions, alleged and real, which existed in that reach of the river.

Most of the great fisheries of the Delaware are on the Jersey shore,

*As I write I am informed that commendable exertions have been made against the fish baskets below Columbia. My life for it, this will result in good, and its good effects be shown even upon the take of the approaching season.

though a majority of them are owned and operated by Pennsylvanians. We found that the greatest cause of complaint on the Delaware were, as on the Susquehanna, unregulated and indiscriminate gill netting in the tide water fisheries, and fish baskets or eel weirs, as they are called, and brush or fascine netting on the upper waters.

Unless fish baskets and permanent brush nets be entirely abolished, and gill netting regulated, the fisheries of the Delaware are fated to ultimate annihilation. It is only a question of time. There are three permanent structures in the upper Delaware, belonging to large vested interests, which have been much complained of as injurious to the fisheries. These are Scudder's dam, the head race of the Lehigh company's pumping wheels, at New Hope, and the inlet of the Delaware and Raritan canal feeder. We examined all these carefully, and found that they were more or less injurious. But no one of them is as bad as an ordinary fish basket, and if the two other interests follow the example of the Trenton Water Power company, who, at the Scudder's dam feeder, have adjusted across the head of the inlet a rack, pendant from a boom of logs, to be used during the fishing season and the descent of the fry—a very cheap and movable structure—the cause of complaint will be very much diminished.

It is not doubted that the great interests owning the works alluded to will, at the suggestion of the commissioners, at least endeavor to ameliorate these obstructions—seeing that they can hardly be asked to remove them altogether.*

The united commissioners of New Jersey and Pennsylvania are now preparing legislation, to be offered to the consideration of both the States, during the present sessions of their respective Legislatures, which, if made law and carried out, it is hoped will retard the decline of this all important interest.

Delaware is equally interested with New Jersey and Pennsylvania, in the passage of these laws. But her sessions are bi-ennial, like those of Maryland, and 1870 was an off year, so that the appointment of a commission for that State could not be effected simultaneously with those appointments in New Jersey and Maryland.

The Legislature of Delaware is now, however, in session. Should Pennsylvania and New Jersey agree upon concurrent legislation, the same will be presented for consideration to the Legislature of Delaware, directly, with the hope that it can be passed without the aid of a commission for that State.

The inland fisheries of the whole Atlantic coast of North America, we have now ascertained, from Hampton Roads, the outlet of the Chesapeake bay, to the Gulf of St. Lawrence, all have suffered and are suffering from similar causes.

In the early settlements of the countries bordering these coasts, the fishing was so abundant, that it did not seem to be in the power of man to reduce them, and laws in respect to them seemed almost acts of supererogation. But abuses have crept in, and grown to such an extent, that even the most important of all the fisheries along the coast, bid fair to be finally consumed and destroyed.

The British provinces have given great attention to this subject, taking example from their home government, and from their neighbors in the New England States. And they already report manifest improvement in many of their fishing grounds, sufficient to afford cause for reasonable hope that

*This subject will be treated in detail, with diagrams, &c., in the report of the New Jersey Commissioners to the Legislature of that State, during its present session.

the fisheries can be brought back to their pristine plenitude. Their reports upon the marine and fisheries, published annually at Toronto, by order of the Dominion parliament, are exceedingly interesting, appearing in the form of quite a respectable "blue book."

They are sustained by all the New England reports. Wherever the subject has been taken hold of and intelligently handled, success has followed.

From the reports of the British provinces, and of all the New England States, and from what we see before our eyes, it seems to be certain, that the production of almost, if not all of our land-locked and migratory—or as it is now fashionable to call them—*anadromous* fish, has been reduced to the facility of a manufacture.

Ninety per cent. of the eggs of trout can be impregnated and raised to maturity, notwithstanding that it takes nearly two months to hatch them. There are establishments rising up all over the country, where trout will live, that actually succeed in that extraordinary proportion, carrying on the affair as a regular mechanical business.

Attention was drawn to this subject by the report of your Commissioner in 1869, and it seems not without some perceptible effect. Trout manufactories are springing up everywhere. All that is wanting is a spring sufficiently copious to supply three successive ponds with water, in such quantity as that the temperature of these ponds will not rise above 60° Fahrenheit, during the summer. This is a rule quite easily understood, and it must be complied with, or there will be failure.

The three ponds are: No. 1, for the troutlings—say little fellows born in the winter, who would be preyed upon by their older brothers and sisters; No. 2—trout of the second year, who, although perhaps not often preyed upon and swallowed, are a tempting morsel for the older ones, and No. 3, a pond for the mature trout—furnishing spawn for the factory, and messes for the table. In the third pond they may be let live for years, until they attain the weight of three and four pounds.

From the lower pond (No. 3) to the head of the spring there is a fish ladder constantly ready for the adults to ascend when under the influence of the procreation instinct; which, as soon as it assumes power, is invariably obeyed, and the males and females ascend to be caught in a convenient reach of the little stream, and be relieved of their respective burdens; not by the *Cazarean* operation exactly, as *Macduff* was brought into the world, so that it could not be said of him, that he was "one of woman born," but by a very gentle process of manipulation in the hands of an expert; whereby the common product of both the sexes is passed out into a tin trencher scarcely larger than a pie dish, in which impregnation of *thousands* of the *ovæ* takes place, and is effected by a mere movement of the dish similar to that which our grandmothers used to employ to cool their tea in a saucer.

In twenty-five minutes after the commixture of the milt and the roe has been effected in the dish, impregnation is certain, and the *ovæ* assumes the form of opaque amber beads about the size of early spring peas. These, so long as they preserve this orange tawney color, are known to be sound. If, however, they become in the least addled, they assume a creamy hue, and must be removed, or the mortality would spread rapidly to the healthy ones. They are then, with the utmost care, handled by extremely delicate and ingenious instruments, and ranged upon rods, a system of glass rods placed just below the surface of the water, the rods being placed near enough to each other so that the *ovæ* will not fall through. The water must be kept constantly fresh and at an even temperature between 50° and 60° Fahr.; and in fifty or sixty days the little fry breaks its shell and drops

from between the rods into the lower depths of the water in which it is free to paddle about.

For three weeks it is sustained in this water (ever running, ever fresh, pure and cool) by a yoke sack which it brings into the world out of its parent egg, and requires no other sustenance. At the end of that time, however, the yoke sack sloughs off and the perfect troutling is obliged to sustain itself thereafter.

From its cradle or crib trough it is then removed by means of fine dip nets and placed in an artificial running stream for a few weeks more, fed by its proprietor with small quantities of curdled milk or chopped liver, (calves'), until it is deemed to be strong enough to be thrown into pond No. 1; here it finds grass and "small deer" of one kind and another, and is occasionally treated to worms or other food by the owner or custodian of the ponds until the next spring, when it is transferred to pond No. 2, a respectable little "chappy" five or six inches long, full of life and animation. In No. 2 he plays about for a year with his mates, growing in vigor and size until the following spring, when he is allowed to associate with the adults in No. 3, (being somewhat too large for a mouthful,) until he is impelled by the instinct of propagation to ascend the ladder toward the place of his birth; there he and his lady love are obliged to submit to the manipulation of the expert, and he and she are returned to pond No. 3, to swim about for another year, when they again ascend the ladder toward the breeding reach.

To such perfection has this system of trout breeding reached, that, as has been stated, there are scarcely any failures. I venture to say that in an ordinary manufacture of inanimate things, say in the making of horse-shoe nails, there are more individuals spoiled by accident than there are trouts or trout *ovæ* killed by the beautiful system of culture now in vogue in many parts of the United States.

This system originated in France, and has been, I think, likely, brought to its present perfection in this country. There are several establishments of this kind in Pennsylvania, and they are growing every day in numbers.

At Williamsport, in Lycoming county, they have been very successful. In Centre and in Cumberland county, also, or perhaps within the borders of Perry, an establishment has been started by Harrisburg gentlemen.

Seth Green, of New York, at Mumfords, Monroe county, near Rochester, is extensively engaged in this new branch of industry. He, indeed, is one of the great lights on the subject, having received medals from foreign governments for his ingenious improvements.

Dr. John H. Slack, of Bloomsbury, New Jersey, (nearer home) has, I think, almost, if not altogether, reached perfection at his place; for his production in fish reaches, I am told, over ninety-five per cent. of the exuded *ovæ*. And Mr. Thaddeus Norris, of Logan Square, Philadelphia, is an authority that may profitably be consulted in regard to this interesting industry.

The cultivation of trout, then, may be said to be thoroughly started, and may be well left to the individual energy and enterprise of the American people—an energy and an enterprise which have never yet failed of success in whatever direction they have turned their hand.

It will not be many years until live trout will be sold from tanks in our city markets, as plentifully and as certainly as hens' eggs are now bought and sold, and the household aquariums will have hatching troughs attached for the amusement of our families, in their very sitting rooms and parlors.

The artificial propagation of shad, however, is a more important matter than that of trout or any other of the inland fish, and, so far as hatching is concerned, the success attained has been quite equal to that which re-

sulted from trout hatching. As many *ovæ* or eggs of the shad can be brought to life as of trout, say 98 *per cent.*, and by a much simpler process.

Shad has the advantage of requiring but as many hours as the trout require days for incubation. At the proper season fish, male and female, are caught and manipulated in the same way. The spawn, having been impregnated, is then placed in a floating box, with a wire screen at the bottom, and anchored so that the wire screen, being exposed to the current, the spawn are kept in gentle motion. In sixty or seventy hours the fry make their appearance and are liberated, when they immediately make for the main channels of the stream, depending, it would seem, upon their being almost transparent for safety from their many enemies.

They live, apparently, upon the microscopic productions of the water itself, until the autumn, when they, having grown to the size of five or six inches in length, they drop down stream tail foremost, until they reach the sea, where it is supposed they remain, certainly until the second, but according to some naturalists, until the third season from their incubation; then, impelled by the instinct of propagation, they return to the places where they were spawned, and in their turn produce *ovæ*, to go through the same tri-ennial vicissitudes.

Some suppose that, like certain insects, having fulfilled their instincts of propagation, they die and are devoured by the fish of prey which are always on the watch, as a sort of residuary legatees. But this would leave us no means of accounting for the large sizes to which shad have been known to grow.

The three-year-olds are supposed to reach from four to six pounds in weight, according as they may have been early spawned, and have reached the sea early in the year of their birth. But shad of eight, ten, twelve and even thirteen pounds in weight, were not at all uncommon in the old days, and such weights could scarcely have been attained in three years.*

It is certain that the lying-in of the shad is an exceedingly precarious time. Relieved of their load, they find themselves very much exhausted, and, no doubt, many of them die.

The late ones are almost sure to die, for it has been ascertained that that they cannot live in water much above 75° Fahr. But those who pass the period of parturition early, say in May or June, may, by a concurrence of fortunate accidents, be carried back to the ocean, (by a June flood, for instance,) and thus have a chance at a renewed lease of life.

The late ones, however, are extremely likely to die of what might be called puerperal atrophy. Parturition leaves them in a weak and flaccid state, incapable of exertion. The heat of the water enervates them, and unless hurried back fortuitously to the saline waters where they originally attained their growth, dissolution is extremely probable.

In the later months of the summer the dead mothers are often seen floating or half floating, amongst the young progeny which they had brought into existence, toward the estuaries of our great streams, and preyed upon by the thousand different ghoulish smaller fry, who get their living from the decayed carcasses of the larger fellow-denizens of the stream.

Now, it has been shown that for the purpose of producing or re-producing trout, all that is required is a sufficiency of water, at an ascertained low temperature. By means of properly fenced ponds and protection from each other, more than ninety per cent. of all the eggs can be made into full

* There is at least one living witness of a fourteen pound shad, and reliable hearsay testimony up to a sixteen pounder!

grown trout. Given any quantity of pure running water, at a continuous temperature, not higher than sixty degrees Fahrenheit, and as many trout as can live in such quantity of water can for a certainty be produced. This because the trout can be confined in spaces, and saved from the natural vicissitudes through which the tribe has to pass. Hence, as has been stated, they are likely soon to become as much an article of merchandise at the shambles, all alive and kicking, as chickens or eggs.

But to this perfection we can not insure the production of shad. What we can do in that line, however, can be stated with equal certainty.

A mature female shad, it has been ascertained, will contain, say one hundred thousand eggs, and if she be left to herself, and the ordinary accidents attending shad birth or spawning, she will make her deposits, which, the instant they leave her body, are subjected to a thousand accidents and dangers—pisciverous speculators hanging about the spawning nest. And although she may have protected her progeny with maternal instinct, by covering them with sand or gravel until the few hours necessary for incubation shall have passed by, yet a vast proportion of them are destroyed or devoured. It is estimated that out of the one hundred thousand, at most five hundred, after having been hatched, find their way to the concealment (so to speak) of the main channel. Even these five hundred are exposed to multitudinous dangers. Enemies lurk in every place of concealment, ready to pounce on them upon the least exposure. They are exceedingly delicate and tender. It is said that if they be deprived of a very few (not more than half a dozen) of their many scales, it is almost certain death to them, and hence, when drawn into a fish basket, the mere shock of striking against the slats kills them.

Beset as they are with all these dangers, it is fair to estimate that not over one hundred of the one hundred thousand reach the ocean; and one hundred to a single mother who has spawned, might be esteemed a fair average product.

But now, let us see what artificial culture will do. Instead of five hundred being liberated in the main channel, no less a number than ninety-eight thousand young fry have been sent out swimming from the hatching box. Let these be reduced by the same dangers and accidents after they have reached the mild stream, in the same proportion as the five hundred are estimated to have been reduced, and instead of one hundred from one mother reaching the sea, we have no less a number than nineteen thousand six hundred from a single ventre. This shows that the breed of shad can be indefinitely multiplied, and that if anything like fair play is shown, the streams can be re-stocked, even beyond their former fruitfulness.

But a fish basket is a contrivance that catches every thing which the stream lets float into it, alive or dead, that cannot pass through its meshes. The pickerel—the cat fish—the rock fish—the eel—the bass—all the pisciverous tribes together, in the largest conceivable numbers, cannot destroy as many of these unfortunate shad fry as the murderous fish basket. They clog up the meshes, and have to be shovelled away by the bushel—by the cart load, if there were carts to take them.

Compromise baskets have been made, the meshes three-fourths of an inch apart, the corners bevelled, etc., etc., but notwithstanding all this, fish basket or kiddie—thy name is *murder*. The tender shad fry, even having passed through the mesh, if it shall have scraped its little body in the least, is sure to die. It cannot part with a scale on its way to the sea, without endangering its existence. The fish basket, then, must simply be abolished, or, as Magna Charta has it, “demolished.” It is the common enemy, and all good citizens should make war upon it.

The Delaware fisheries are as much injured by the fish baskets and permanent fascine, or brush nets, as those of the Susquehanna.

The convention of the Pennsylvania and New Jersey commissions, after diligent inquiry, found that the very same complaints exist on that stream. They found, even amongst the proprietors of fish baskets, a growing and healthy opposition to them. Many of these honest men testified that they would be glad if they were abolished, but so long as they were permitted they saw no harm in keeping up their own.

Quite an improvement was observed in the run of shad on the Delaware in the spring of 1870. Fish were caught higher up the stream than they had been for years, and shad spawned in the upper reaches of the Delaware beyond the New York State line. This shows that all that is required is proper regulation of the inland fisheries by law, and all will yet be well, for, with our power of propagation, we can supply any reasonable falling off, occasioned by a poor season, or any other natural reduction of quantity.

I applied to the fish commissioners of New York for any suggestions they might have to make in reference to the Susquehanna or the Delaware rivers, seeing that the Empire State was riparian to the upper reaches of both these streams. They replied that they were satisfied with the exertions which were being made by us in the lower reaches, and that whatever improvements we made would, in the end, benefit them. That when the shad began to return to the extreme northern reaches, in Pennsylvania, of those rivers, it would be time enough to look toward concurrent legislation, as between New York and Pennsylvania.

That shad will eventually be caught, both on the Susquehanna and on the Delaware, within the New York line, I have not any doubt—but the Augean stables must first be cleansed.

The experience of all the New England States, and of New York, in reference to their inland fisheries, is precisely analogous with our own. Fishing has been practiced in all their streams as if the supply was infinite and inexhaustible. There has been no law, or if laws have been passed, they have not been observed. The splendid Connecticut, the mighty Hudson, have both had their fisheries so much depleted that fear of actual annihilation has induced the riparian States to pause and deeply consider the subject. We, delayed as we have been by the necessity of long legal inquiries, by divided riparian ownership, and by the bi-ennial sessions of the Legislatures of co-riparian States, have not lost by this delay. Several of the States north of us have invested considerable sums in the artificial propagation of the anadromous tribes, and with apparent success, too, for the catch in the Connecticut of 1870 outnumbers any catch for twenty-five or thirty years. On the Connecticut, the first or about the first artificial hatching was inaugurated three years ago, and it is the belief of all that the catch of this last year, 1870, is the result of that plant.

How can it be otherwise, when, by the artificial process, you can give life to the spawn and set swimming in the stream nearly one hundred thousand shad minnows for a bare five hundred or a thousand brought to life under the maternal fins.

On the Hudson, the pioneer shad producer, Seth Green, has been now employed for two years sending out millions upon millions of these little denizens at the expense of the State of New York. We shall assuredly get returns from these hatchings in due time; it is believed that three years will tell the story. That period has told the story on the Connecticut, and similar results are confidently expected on the Hudson; but in the meantime the lower Hudson is clogged by systems of fishing inimical to the in-

crease due to that splendid river. There is a sort of impounding practiced there which takes all the fish of all sizes that enter within the pound or enclosure. The smaller and growing specimens are not merchantable, and are therefore lost as food, and lost as to their propagating powers to posterity. The New York commissioners actually dread the total destruction of the Hudson fisheries unless the laws be thoroughly revised and enforced, and abuses which have been growing for ages be put an end to.

There are thousands of men about the New York bay who gain a precarious and scanty living by these injurious methods of catching fish. The prejudices of this class of men are to be fought and overcome; all fishing must be placed on a fair and proper basis; wholesome laws must, as I say, be enacted and enforced, and our experience will prove to be the same as those of the European countries which first took up this subject. The fisheries have improved both in quantity and quality wherever they have been brought under the action of judicious and salutary law. The practices and prejudices of years must first, however, be uprooted.

We have suffered in the Delaware and Susquehanna both, from similar causes; and legislation will be suggested to the riparian States during the present sessions of their respective Legislatures, looking toward a more hopeful system, and drawn up, after due reflection, upon the experience of the States who have, as yet, instituted commissioners and reformed the laws on this important subject; legislation, it is to be hoped, which will meet the approbation of the bodies to whom it shall be submitted, and which will result in rehabilitating our grand fisheries.

Pennsylvania possesses the largest portion of the two most important shad breeding rivers in this continent; they are the greatest and the best. Let us clear them of their obstructions first, and then follow the example of New York and the New England States in propagating the anadromous fishes.

A private experiment will be tried with salmon, on the Delaware, as soon as *ovæ* can be procured. Dr. Slack, of New Jersey, one of her fishery commissioners, and an enthusiastic culturist, has promised to let a few thousand salmon into our great eastern stream, at his own expense. We shall know whether he succeeds or not in three years from the hatching of the fry.

Should we succeed in obtaining concurrent legislation with Maryland, in respect to the Susquehanna, the State can then open a dam or two on that river and its tributaries, and commence propagating like her neighbors of New England.

It will not be worth while, however, until the stream shall have been thoroughly freed from obstructions. The Delaware may be practised upon in the same way, in which there is no permanent obstructions for over two hundred miles above Philadelphia, shad having been spawned above Deposit, in the State of New York, during the season last past.

If, against the thousand temporary impediments, natural and artificial, these fish can penetrate to such a distance, what will be the result when the young shad shall be increased in production many thousand fold, and they shall be protected, not to prohibition, but within fair bounds of regulation? There is no reason why shad should not be re-produced in these streams to an extent greater than they were ever known before. Salmon even may yet be introduced, and, if with success, what a blessing.

And now as to other fishes. We have disposed of trout; that has already become a recognized industry, and though not yet fully developed, full development is within every man's ken, and will soon be effected; and unless trout in a man's aqueous closes are still regarded as *feræ naturæ*, and liable to be taken by any passing angler without let or hindrance, I

know of no law required for the protection of this industry. If this be the case, however, legislation should change it, and an invasion of a man's ponds should be made a trespass *quare clausum fregit*, as the invasion of his orchard or other curtilage is now. This subject is being inquired into, and will receive attention in the legislation to be submitted for consideration during this session.

The most popular fish now to be found in the upper reaches of the Susquehanna is the pike perch, (called erroneously Susquehanna salmon,) a superb table fish, (superior to the famed moscalonge of the St. Lawrence,) which is almost banished from our boards from the effects of fish baskets and other unfair modes of fishing. All Pennsylvanians, of the interior, know this fish and must appreciate its very great value if it could again be made plentiful. Then we have the yellow perch, a very fair pan fish, which has re-appeared above the Columbia dam within a few years. Then the Susquehanna eel, of which about a ton were caught in a fish basket last season, above Harrisburg, destroying, probably, about the same weight of small fry of other species. It is true that the eel is a preying fish, and watches the shad breeding process, devouring all he can capture. But this is natural, and it was so in the early day, when shad used to be caught here, four and five thousand at a haul. I am not afraid of eels, they are so pleasant for the table that their numbers will be reduced in fishing. Then we have the rock fish, the cat fish and the sun fish, besides others. All these, were our laws properly observed, would increase and multiply. It seems a wonder that they have been so reduced, but fish baskets catch everything, great and small, and considering this, the wonder ceases.

A fish, called black bass, was introduced a year or two ago from the Potomac, which originally came from the Ohio waters. Some gentlemen in Harrisburg let loose just five dozen of them. These are increasing. At Newport, in Perry county, last spring, as has been stated, the boys discovered a number of their dead fry in the fish baskets near there, and brought them up to the village as curiosities, to ascertain from their adult friends from whence they came. I wonder how the gentlemen will like this, having paid about a dollar a piece for their progenitors? Large individuals of this colony have been caught in various localities and let loose again. They are a hardy fish, and know well how to take care of themselves, and they will increase and multiply, if protected. They have been also introduced into the Juniata, the Delaware, and into the Schuylkill. About a thousand were let loose near Easton last fall. There is scarcely a more interesting hook and line fish known than these black bass, and they are a great dainty for the table.

They, like the eels, are also said to be pisciverous by some, though it is denied by others; be it as it may, though I think the weight of authority is that they are not voraciously pisciverous; but, be it as it may, if we catch them catching our shad, we will catch them, and some folks say they are as nice a table fish as the shad themselves. I think, then, that both in the Susquehanna and the Delaware the black bass should be protected. And the New Jersey commissioners, although originally and even now distrustful of them finding Massachusetts and Pennsylvania less alarmed upon the subject, have gracefully yielded their objections and will recommend protective laws. I do not fear the natural enemies of the shad; it is the practical devices of man that I dread the most. Let our streams be regulated and policed, and no crusade need be made against any particular tribe.

Regular sea salmon are to be tried, as has been said, in the Delaware, and Dr. Slack, of New Jersey, writes me that he is in treaty to obtain some

spawn of another very fine variety—the land-locked salmon, evidently of the salmon tribe, but which does not appear to be anadromous.

These are found in the St. Croix, one of the most northerly of our rivers, bounding Maine and the British possessions. It is like the black bass in size, and sometimes attains the weight of ten pounds.

The New England commissioners have been hatching at it for two or three years, and New York also is trying to transport it. Conceive how our rivers would be improved could we fill them with such splendid angling fish as these, the sea salmon, the black bass and others, which we need not "count" until there is some hope of their being "hatched." Yet other States and nations have so improved their fisheries and why not we?

The Delaware and the Susquehanna are the two most extensive and favorable streams for fine inland fishing on the Atlantic slope of our continent. Their upper reaches, both, in the olden time, produced the finest shad known to the coast, and in the greatest abundance. They can both be made again to teem not only with shad, but certainly with black bass, with pike perch, with eels, rock fish, yellow perch, sun fish, &c., and probably with sea salmon and land-locked salmon. There is nothing required for this except a few well considered statutes, and the certainty of those statutes being executed. Our two great streams, however, have diverse riparian municipal interests. New York and Maryland border portions of the Susquehanna; New York, New Jersey and Delaware border portions of the Delaware.

Our statutes, to be of avail, must be concurrent, and as some of these States have bi-ennial sessions of the Legislature, it will take time to make the legislation homogeneous. Our energies must, however, be directed so that the laws must be the same for all the riparians and must be fair to all. Fortunately the best laws that can be passed favor all interests. Interests which at first may seem to be oppressed will at last be benefitted. This is no mere prognostication; it is the truth, ascertained by experience. The reports of the fishery commissioners of all States in which they exist are full of such experience, and a firm execution of the laws must not, therefore, be shrunk from.

There are those who sneer at the idea of fish-ways and fish-ladders. Our fish-way at Columbia is considered a humbug. Since it has been formed I think it can be proved that no season has passed in which there were not at least five thousand shad caught above it, and those shad must have worked their way through some aperture or other.

Since it has been formed no season has passed in which, in the autumn, thousands upon thousands of small shad fry have not been caught in the kiddels and fish-baskets, all located above the fish-way, and their mother's must have got up through some opening. If not through our fish-way, then how?

But if no fish pass through ours, there are plenty of them in New England through which they can be seen passing any day in the season. If ours is not as good as theirs (and I think it is better, because our dam is so much lower) then let us make fish-ways like theirs. A Pennsylvania shad can swim as well as a Yankee shad, and let us make our ways like the Yankee ways when the time comes. That ways can be made up which shad can pass is as certain as that there are "holes" in rooms made by "carpenters" through which men and women can pass. But you can't have your cake and eat it if you kill your young shad in fish-baskets as they go down the river. I admit that *those* cannot make their way back over a fish-ladder whether Yankee or Pennsylvanian.

The fish ways are the smallest of our difficulties. Let us regulate our

fishery laws, and there will be no trouble about the fish getting over the dams.

The Delaware is not interfered with by dams at all for two hundred miles or so above tide, yet in the upper reaches the fishermen consider shad fishing an industry of the past, and hope to supply the place of the lost tribes by the introduction of black bass.

Our people shall have both, and in the greatest abundance; but a healthy public sentiment must be cultivated and established; the fisheries must be regulated; we must follow in the train of our European ancestors. They lost their fish as we have lost ours, and have regained and their sons are regaining them very fast. We shall succeed equally well with our cousins. We never yet have competed with them in any way without holding our own, or beating them, and it will be so in respect of our fisheries.

In New England a great interest has sprung up in favor of the restoration of the fisheries. Scores, perhaps hundreds, of small independent fish culture establishments have come into existence and are succeeding. Shad, salmon, land-locked salmon, black bass, and even lake trout have been hatched and set free. The catch of shad last season in the Connecticut was better, as before stated, than it has been for twenty or thirty years, which season being the third from the time of the first artificial supply, the increase is justly attributed to that method of hatching. Prejudice is dissolving, as it always does when combatted by quiet persistence in the right cause.

New York has not been behind Massachusetts in the good work. Vast numbers of shad have been artificially hatched in the Hudson, during the last two seasons, and set free. There has not been time for results, but the Hudson has been fished with extreme irregularity, and its vast supplies have been reduced by the same lack of economy which has weakened our fisheries in the Delaware and in the Susquehanna. Laws opposed to this system, or no system, have been passed in New York, and the fishermen are beginning to believe that a well regulated order of things will bring around prosperity again. They submit cheerfully to all reasonable ordinances.

Over the territory of the New England States, and of New York, numerous lakes are to be found. All these are great resources of fresh water fish, of which new varieties are being continually introduced and with uniform success.

The States have ownership in these lakes, and a system of leasing them to private parties has been commenced. In Massachusetts the State has domain in every pond greater than twenty acres in area, and these she has commenced to profit by through these leases.

A similar system will, no doubt, be inaugurated in New York, the Empire State possessing a very large share of these inland reservoirs.

In Pennsylvania we have very few lakes—so few that it is believed that all have been merged in the patents issued by the State, so that they are mostly, if not all, private property. The innumerable branches of our grand water courses, and our few lakes, may then be said to be held by the riparian proprietors. This will not prevent their productiveness as fisheries.

The system of fish culture is making such headway, and is becoming so popular, that the capacity of all our interior waters will, at last, be availed of by the owners, and we shall have fresh fishes in great variety, as plentiful with us as the most richly endowed of our neighbors. Well considered laws of general application, with an occasional deviation to satisfy the conditions of peculiar localities, should be passed *and observed*, and all will be well.

The New York Fish commissioners have applied to the Central Park commissioners, and have received permission to add to the Zoological department of the Park, the hatching and culture of fishes. From this arrangement there is much to be expected. All varieties of inland fish that will flourish in this climate will be hatched in the waters of the Park, and citizens from all parts of the United States will constantly receive information on this subject, as a consequence of this judicious and liberal policy.

Our duty in Pennsylvania is very simple. We have the two queen streams, within and upon our borders, for anadromous fish, in the United States. Let us join with the other States riparian to these great rivers—let us pass concurrent laws—fair to all—beneficial to all honest fishermen and honorable sportsmen, and afterwards “keep” them, to use a Scriptural phrase. Our people are becoming more and more alive to the subject. At the recent convention of the Pennsylvania and New Jersey commissioners an offer was made by private gentlemen, through Mr. Thaddeus Norris, that if the Delaware were cleared of piratical fishing, they, at their own expense, would try the artificial hatching of shad for a season. When the streams are cleared, however, and further favorable reports continue to come up to us from the east and from New York, it will be perfectly safe for the State, following the example of her neighbors, to plant these migratory fish in these rivers, for two or three consecutive seasons, with a certainty of success, leaving it to private enterprise to introduce the land-locked tribes, which only require protection from piracy to multiply indefinitely from very small beginnings. The five dozen black bass planted by Harrisburg gentlemen, a couple of years ago, have already produced shoals of minnows of their species, which are now being sacrificed in the kiddels. The Potomac, as has been seen, was filled with them for two hundred miles of its length, from a single mess brought over in the tank of a locomotive from the Monongahela. Let us protect these enterprises, and they cannot fail of success.

The New Jersey and the Pennsylvania commissioners have convened three times during the last season, and will, very shortly, suggest legislation, the result of the most careful inquiry and reflection on this subject, regarding the Delaware. The same will be presented to the Legislatures of Pennsylvania, New Jersey and Delaware for consideration. It is to be hoped that the wisdom of these bodies will produce a uniform system common to all, and of service to all. Until the legislation is homogeneous and concurrent, there is but small chance of improving our fisheries.

Concurrent legislation on the subject of the Susquehanna is necessarily delayed until the meeting of the Maryland Legislature, which will not take place until next winter. Let us then dispose of the Delaware this year, if practicable, leaving the Susquehanna till Pennsylvania and Maryland can act together, as Pennsylvania, New Jersey and Delaware can act this year, providing they can agree.

Let our two grand rivers be first rehabilitated. Their tributaries will, thereafter, almost regulate themselves.

The great movement has commenced. Let the streams be prepared. First by protection from piracy, then by opening the dams. Let artificial hatching then be inaugurated and the fisheries of these rivers will yet rank amongst the most valuable of these material interests.

I have the honor to be,

Sir, very respectfully,

Your obedient servant.

JAMES WORRALL,

Commissioner, &c.

a Board of Canal Commissioners," providing (*inter alia*) that the Governor be required to appoint five Canal Commissioners, and defining their duties, *prout* said act, made part of this special verdict, and contained in pamphlet laws of sessions of 1824-5, beginning on page 238. That on the 25th day of February, 1826, an act was passed, entitled "An Act to provide for the commencement of a canal to be constructed at the expense of the State, and to be styled the Pennsylvania canal," authorizing (*inter alia*) said commissioners to immediately locate and construct a canal, and locks and other works necessary thereto, from the river Swatara, at or near Middletown, to or near to a point on the east side of the Susquehanna, opposite the mouth of the Juniata river, as in said act provided; *prout* the same contained in pamphlet laws of session 1825-6, beginning on page 55, and made part of this special verdict. That on the 9th day of April, 1827, an act was passed, entitled "An Act to provide for the further extension of the Pennsylvania canal," providing (*inter alia*) that said Canal Commissioners should, as speedily as may be, locate and contract for making a canal, locks and other works necessary thereto, up the valley of the Juniata, from the Eastern section of the Pennsylvania canal, to a point at or near Lewistown, as therein provided; *prout* said act contained in pamphlet laws, session of 1826-7, beginning on page 192, hereby made part of this special verdict. That by virtue of the act first above referred to, and its various supplements and substitutes, the said Board of Canal Commissioners continued to exist until the year —. That the said dam and structure in the indictment in this case mentioned and described, was constructed and erected by said Board of Canal Commissioners, at the expense and cost of the State of Pennsylvania, long prior to the year 1857, to wit: On or about the year A. D. 1826, and as one of the necessary works connected with the construction of the Pennsylvania canal, as above provided; and that said dam thenceforth continued and still continues to be used as a part of said canal.

That on the 16th day of May, 1857, an act was passed, entitled "An Act for the sale of the main line of the public works," which provided for the sale (*inter alia*) of the canal mentioned and described in the foregoing acts as the Pennsylvania canal, as therein set forth, which act, contained in the pamphlet laws of 1857, beginning at page 519, and an act, entitled "An Act relating to certain canals," contained in the pamphlet laws of 1864, page 725, are hereby made part of this special verdict; *prout* the same.

That in accordance with said act of May 16, 1857, the said canal (*inter alia*) was purchased by the Pennsylvania railroad company, and a deed was executed and delivered to said company therefor, as provided in section 7 of said act; *prout* said deed hereby made a part of this special verdict, the same being dated July 31, 1857.

That on the first day of May, 1866, an act was passed, entitled "An Act to incorporate the Pennsylvania canal company," which act contained in pamphlet laws for 1866, beginning at page 1068, is hereby made a part of this special verdict.

That in accordance with the powers conferred by said act, the said Pennsylvania railroad company, on the 30th day of March, A. D. 1867, sold and conveyed the line of said canal from Columbia to Hollidaysburg, to said Pennsylvania canal company, as by said deed recorded in the office of the recorder of deeds, in and for the county of Dauphin, in Deed Book C, vol. 4, beginning at page 156, will fully appear; *prout* the same, hereby made a part of this verdict. That on the 30th of March, 1866, an act of the Legislature was passed, entitled "An Act relating to the passage of

fish in the Susquehanna river and certain of its tributaries ;" which act contained in pamphlet laws of 1866, beginning at page 370, is hereby made part of this special verdict ; *prout* the same with the supplement thereto, passed April 13, 1867, and contained in pamphlet laws of 1868, page 79, *prout* the same. That James Worrall was duly appointed Commissioner, by the Governor, as provided by said act and said supplement, and entered upon and performed the duties devolved upon him by said appointment, under said act and supplement, and did, within the time limited and designated in said act, fix and designate the location of the wiers, steps, sluices and other devices for the free passage of fish up and down said river and through the dam and obstruction, in the indictment in this case mentioned and described, and did furnish working plans of the same to the owners thereof, to wit : the defendants herein, and did in all things observe, perform and conform to the provisions and requirements of said act and supplement.

That said defendants have not hitherto made said sluices, wiers or other devices, or any sluices, devices or ways for the free passage of fish up and down the said river, through said dams and obstructions in the indictment in this case mentioned, according to the plan furnished by said commissioners or otherwise, but that said dam and obstruction remain in the same condition, in all respects, in which it was before the passage of said act of March 30, 1866, and is an obstruction to the free passage of fish and spawn up and down said river.

If the court, upon the facts stated, should be of opinion that the defendants are guilty in manner and form as they stand indicted, then we find defendants guilty, and judgment to be given accordingly ; if not guilty, the verdict and judgments to be for defendants.

OPINION OF THE COURT.

By the court :—The State of Pennsylvania, about the year 1827, constructed a dam across the Susquehanna river, at Duncan's island, for the purpose of feeding its canal, then about to be completed, and kept it up to supply the public works with water until the year 1857, when the whole right of the State was conveyed absolutely to the Pennsylvania railroad company by deed, pursuant to the provisions of the act of May 16, 1857. That company made use of the dam for the same purpose, until it sold and transferred all of its interest in the property, from Columbia to Hollidaysburg, including the dam *now* in dispute, to the Pennsylvania canal company, in pursuance of the act of May 1, 1866, by which that company was incorporated, and authorized to make the purchase. The Susquehanna is one of the great rivers of Pennsylvania, navigable by nature, and over which the State has exclusive control by virtue of its right of eminent domain. The claims of riparian owners to its shores run no further than ordinary low water mark, and between that and the high water boundary, the public has the right of free passage, and the State the privilege of taking possession at any time without making compensation to the land owner, who has but a qualified property in the intermediate space.—*See 1 Penna. R.*, 467 ; *1 W. & S.*, 346 ; *6 W. & S.*, 112-13-14.

The dam was, therefore, the absolute and unqualified property of the Commonwealth, which by its deed, made in pursuance of the act of 1857, conveyed all of its rights therein to the Pennsylvania railroad company on the 31st day of July, of the same year. The act of Assembly authorizing this conveyance, is most full and ample, only reserving the power in the State to revoke the grant for misuse or abuse of the privileges granted after a *judicial decree* of such misuse or abuse first duly had and obtained.

The railroad company to which this sale was made, held a charter from the State, granted in the year 1846, in which there is no power of change or revocation reserved, consequently it was then and still continues beyond and above legislative control. The State has precisely the same power over property granted to a corporation, that it has over a like grant to a private individual—no more—no less.—6 *Howard*, 533. Thus stood the right to this feeder dam on the 30th day of March, 1866, when the act relating to the passage of fish in the Susquehanna river was passed, under which the indictment in the present case was preferred. The act of Assembly last referred to, requires every individual or corporation having or maintaining any dam, weir or other obstruction on the Susquehanna and its various branches, including the Juniata river, to maintain and keep up at each of said dams, wiers or other artificial obstructions, a sluice, weir or other device for the free passage of fish and spawn up and down said stream, in such manner, and on such plan, as a commissioner to be appointed by the Governor may devise. Working plans are to be furnished by the commissioner who is to inspect the dam, immediately after the 1st of November next, following, and if the device shall not have then been constructed as prescribed, the commissioner is to report the delinquency to the district attorney of the proper county, who is to cause an indictment to be preferred against the delinquent corporation or individual. The failure to erect and keep up devices in the dams, in the mode prescribed by the commissioner, is declared to be a misdemeanor, and the dam a public nuisance; the violaters of the law are subjected to a heavy penalty, and if the work be not completed within thirty days, the dam is to be abated by the sheriff at the cost of the individual or corporation offending. The Pennsylvania canal company, under its purchase from the Pennsylvania railroad company, made on the 30th day of March, 1867, has kept up the dam and neglected and refused to make the sluices as required by the act of Assembly, and consequently was indicted at the November term of court of Dauphin county, and a true bill found on the 21st day of that month.

A special verdict was taken, embracing every fact necessary to raise the legal positions presented on the argument, which we will now proceed to consider. The defendant answers that the statute under which it is indicted was repealed by the act of April 13, 1867, which provides that the several provisions of the second section of the act, entitled "An Act relating to the passage of fish in the Susquehanna river and certain tributaries," approved March 13, 1866, be and the same are hereby continued to the 31st day of December, 1866. On looking into the provisions of the second section thus referred to, we find that certain of its enactments expired in effect on the first Monday of December, 1866—as the duty of the commissioner for instance. If that officer had failed to fix the width of the weirs, steps or sluices, or determine their location on the various dams, to furnish the working plans on which the sluices were to be constructed, to obtain the approval of the Governor thereto or to inspect the same and report the delinquency to the district attorney, the power on the part of that officer had ceased, and it was the intention of the Legislature to prolong it by the act of 1867. The statute is hastily and carelessly drawn; but by applying its words to the provisions of the act of 1866, which had expired, we do not infer the absurdity to the Legislature of intending to continue provisions which had not expired, to wit: the power to indict or punish for keeping up that which the law declared a nuisance, and concerning which the enactment is perpetual. It is our duty to so construe the laws as to prevent an absurdity. This can readily be done in the manner indicated, and such

is the obvious meaning of the act. Apply the maxim, *reddendo singula singulis*, and the two laws may well stand together. Had the act expired as assumed, the legal position that the indictment must fall would have been clearly tenable, for if the law expires or is repealed before indictment, there can be no prosecution, or if after conviction sentence cannot be pronounced. It is scarcely necessary to cite authorities for so plain a position; but we find them in 1 Binney, 601; 1 Wh. R., 460; 1 Wash. C. C. R., 84; 10 Watts, 351; 8 Smith N. Y. R., 95. It also urged that as this law is highly penal in its character, it must be strictly construed, and is *ex post facto* in its operations, punishing that which was lawful at the time it was passed. This statute does not pretend to punish the defendant for erecting the dam, it was lawfully built by the State, and kept up by it and the Pennsylvania railroad company for nearly forty years before this defendant had existence as a corporation. The law does not declare the *erection* unlawful, but forbids the keeping up of the work after the owner has been furnished by the commissioner with the plan devised for the passage of fish, without making the sluices, &c., as required by the statute. It is the failure to make the change after due notice which is declared to be a public nuisance and keeping up the dam in contravention of the legislative command.

It is said that the act of Assembly is in violation of the State and National Constitutions in this: That it impairs the obligations of a contract, between the State and the Pennsylvania railroad company, entered into when the State sold its works; violates the charters, both of that and the canal company, by imposing burdens on them, which neither their charters nor the laws of the land require them to bear, and takes private property for public use, without paying or securing any equivalent. To this it is answered by the Commonwealth that, as the Susquehanna was by nature a public navigable river, the people on its banks had an inherent right of free fishing, which could not be impaired or taken away. That the State possesses the right of eminent domain for the benefit of the people, and cannot part with, sell or abandon it. A charter granted to a corporation is of no greater efficacy, or of more binding obligation, than a deed to an individual; and its franchises are subject to the power of eminent domain, and are under the control of the Legislature; that there is no taking of this property; and even if *taken*, it does not impair the contract. The point mainly relied on in response to the defence is, that this law is an exercise of police power, which the State possesses over all persons or property within its borders, is held for public benefit, and cannot be parried with or abandoned; and lastly, that the exercise of the right complained of is not a violation of the *words* of the Constitution, and before a law can be declared void by the courts on account of impinging with the organic law, it must be clearly so, and come within the prohibition of the very letter. It would be a waste of time, at this day, to argue that a grant is a contract executed, and the property once granted cannot be resumed by the State, without the consent of the grantee. It is equally useless to cite authority to prove that the charter of a corporation cannot be revoked, or altered, against its consent, unless when the power of revocation or alteration is reserved in the grant, in general laws previously passed and applicable to their incorporation, or in the Constitution itself. If the State has in the mode prescribed by law granted a tract of land to an individual for a valuable consideration; it cannot, by law, revoke the grant and resume the property; and even when taken for necessary public purposes, must pay the owner a full equivalent. The same rule applies, both to the franchises and property of a corporation. In the present case the State, for a full and valuable consideration, granted and conveyed its canal and railroad

improvements to the Pennsylvania railroad, a corporation over the charter of which it had retained and possessed no control whatever. That company had held and enjoyed the property for about nine years, when the act of 1866, relating to the passage of fish, was passed. By that law the Legislature attempted to impose on this company the burden of changing all its dams from, and including the one in controversy, up to, and along the Juniata to Hollidaysburg, so as to secure the free passage of fish through all the dams; some twenty-six in number; and the expense of making the directed alterations, it is said will amount to over two hundred thousand dollars, independent of the cost of keeping them in repair. These alterations in the dams, it will be borne in mind, are not for the benefit of the present owner, which will, it is said, be greatly injured thereby in the loss of the necessary supply of water for its canal, but is intended for the benefit of the people at large, and the riparian owners in particular, by securing an abundant supply of fish. We would naturally conclude that in such a case the expense of these alterations should rather be borne by the public at large, or the persons who are to be especially benefitted, than by the purchaser for value, who is to receive no benefit, but will be essentially injured by the change. It is said, however, that there is no *taking* of the property of this corporation under the statute, and therefore it cannot claim the protection of the constitutional prohibition. Although the dam in question is not *taken*, the money of the owner must be to a very considerable amount before the alterations and improvements required by the statute can be completed. It transcends the power of the Legislature to throw such a burden on its grantee. When the Legislature incorporated a company to make a bridge with a draw of thirty feet, it was decided to transcend the power of the Legislature to require the draw to be extended to fifty feet.—18 Conn. R., 54. Also held that a railroad company could not be obliged to make bridges for county roads across their track when the charter contains no such obligation.—2 Barber, 513. Franchises cannot be changed without the consent of the corporators, properly expressed. The Legislature cannot interfere with corporate property or franchises.—*Brown vs. Hummel*, 6 Barr, 86. When no power is reserved for the Legislature to alter the charter it cannot be done, nor can additional burdens be thrown on it without the consent of the corporators.—*Com. vs. the Monongahela Nav. Co.*, 6 Barr, 379. See also *Harrington's R.*, 389, 9 Cranch, 292; *Dartmouth College vs. Woodward*, 4 Wheaton, 518, and numerous other cases. But wherefore investigate these decisions when we have an authoritative exposition of the constitutional power of the Legislature, made in a very recent case by our Supreme Court, which is binding on us as an inferior judicial tribunal, and which we have neither the legal power nor inclination to disregard.

The State of Pennsylvania, some years since, donated the canal extending from the mouth of the Beaver to the city of Erie to a company incorporated to receive, complete and keep it up. The charter required the company to maintain farm bridges; but no mention was made of those on the public streets and highways. The State had built, and was accustomed to keep up those bridges. Some in the borough of Meadville fell into decay and were re-built by the town authorities, which sued the canal company for the expense thereof; but it was decided that the corporation law did not require it to keep up these bridges.—See *Meadville vs. Erie canal company*, 6 Harris, 66. In 1864 an act was passed requiring the company to build and keep up the bridges on the public streets and highways; which the corporation refused to do, and was sued by the city of Erie for the expense incurred in re-building those in that city. But it was held by

Judge Derickson, on full consideration in the court of common pleas, that the Legislature had transcended its power in passing the law; and the judgment was affirmed by the unanimous opinion of the Supreme Court, in a most lucid argument by Judge Sharswood.—See the *City of Erie vs. the Erie canal company*, 9 P. F. S., 174. That was a vastly more favorable case for the exercise of legislative power than the one before us. There the State had originally built all of the bridges on the streets and highways, including those in question, and had always kept them up. The canal was given to the company by words of equivocal meaning, but probably intending to bind the company to do the same thing, but not so expressed. Here the public works of the State were sold to the Pennsylvania railroad company for seven million five hundred thousand dollars. The dam was built, and had always been kept up by the Commonwealth, without any sluice, causeway or other device for the passage of fish, as had all of those embraced in the act of 1866, which the railroad company was required to change at its expense. There was an apparent fairness in the law relating to the Erie canal, as it only required the donee of the State to do what the donor had always done whilst it held the property. There is nothing but unmitigated hardship and injustice in the act of 1866, which obliges a purchaser, for value, to do what the vendor had never done when it built, or whilst it owned and kept up the dams by virtue of its sovereign power. The purchaser had a right to expect it would be permitted to use and enjoy the works as they had always been held and enjoyed by the State, without expense or molestation by the legislative authority. It is said, however, that the State can cause the dams on the river and its branches to be changed or even vacated by virtue of the right of *eminent domain*, an attribute of sovereignty vested in every government for the benefit of the people, and which can neither be parted with or abridged. There is no doubt of the power of this Commonwealth over the public rivers within its borders, and it was by virtue of its sovereignty that it took possession of the Susquehanna, the Juniata and other streams, and obstructed them with dams for what it considered the benefit of the people, although thereby the passage of fish was prevented, and the fisheries destroyed. But it also sold the whole works for what was considered the public good. The dams became, after such erection and sale, private property, and if now taken under the power of eminent domain for public use or benefit, it must be done on paying the owner an equivalent.

The present law proposes nothing of the kind, but on the contrary requires the corporation to make all of the changes and keep them up at its own expense. This transcends sovereign power. It is prohibited by the Constitution. The State might as well undertake by legislation after it had parted with its land to A. for a full consideration, and conveyed it in all the forms of law, to transfer it over to B., and compel A. to make a conveyance, or after it had thus parted with its property, oblige A. to build a church or school house for public benefit on the land at his own expense. One of the highest attributes of sovereignty, and most essential to the existence of the State, is the power of taxation, yet that may be released for a consideration, and cannot be resumed without the consent of the grantee. See *New Jersey vs. Wilson*, 7 Cranch, 164; *Gordon's appeal tax court*, 3 Howard, 133; *Bank vs. Knox*, 16 Howard, 369; *Idem* 416-432, and many others to the same effect. This is the settled law as declared by the highest judicial tribunal in the country—the Supreme Court of the United States.

It is further contended that the State can compel the holder of these dams to fit them for the passage of fish by virtue of its police power; the alteration being of great public benefit and necessary for the welfare of the

people. This power is very extensive in preventing nuisances of almost every kind, as removing noisome smells, offensive trades, dangerous explosive substances, that which is deleterious to health, or dangerous to the lives of the people. The interment of the dead in a great city has been forbidden, although the corporation was expressly created for that purpose, and endowed with the authority to use the location.—*Coates vs. the City of New York*, 7 *Cowen*, 585. Every right is granted under the implied condition that it shall not injure others.—*Idem* 605. It has been held in several of the States that a railroad company could by law be obliged to fence its road, although no such power was retained in the words of its charter, the same being necessary for public safety and that of the neighboring stock running at large.—*See* 12 *Indiana R.*, 3; 16 *Indiana*, 84; 27 *Vermont*, 140. The corporation was subject to police regulations, and may be obliged to enclose its track under the penalty of paying for all cattle killed or injured.—25 *Illinois*, 140; 28 *Illinois*, 284–290. The road takes nothing by inference or intendment, and may be obliged to do whatever the public good requires unless expressly exempt by its charter.—27 *Vermont*, 140.

The right of control over the waters of the State has perhaps been carried further as a police power in the State of Massachusetts than in any other, where the common law prevails, and that whether the franchise was in the hands of an incorporated company, or the property and privileges were claimed by a private individual. The common law may have been changed to some extent by early custom, or the power over the streams of water secured to the public by provincial legislation; for we find it decided as early as 4 *Mass. R.*, 528, that where permission was given to the owner of land to build a mill, as early as 1633, and he was granted a several fishery, the Legislature could require him, after the expiration of a hundred years, to make a passage for the fish, and when badly done to re-build it at the expense of the owner. The whole subject underwent careful examination in the *Commonwealth vs. Alger*.—7 *Cushing*, 534, 101. It was held that the right of free fishing and navigation was a public right, and could be controlled by legislation, although private rights were injuriously affected, (see also 4 *Pick.*, 460, 462, 5 *Pick.*, 199,) and a man may be prohibited from moving timber or gravel from his own land, if by its removal the public is likely to be injured; although by such prohibition the land is greatly lessened in value.—4 *Met.*, 55. On the other hand, it was decided in *Virginia*, that when permission was given to an individual to erect a dam, in the mode prescribed by law, which was done, and long enjoyed, that it transcended the power of the Legislature to compel the owner, at a late day, to erect a lock therein for the passage of boats at his own expense; 6 *Randolph*, 245, considered with great care. So in the State of *New York*, the *People vs. Platt*, 17 *John*, 195, where land was granted covering a stream not naturally navigable, the Legislature cannot impose burdens on the owner of a dam erected thereon before the passage of the law declaring it a highway, without making or providing for compensation. It is impairing the grant, which is in violation of the contract. If a private stream is made navigable, the Legislature cannot appropriate it to the public without compensation.—*Angel on Water Courses*, 601, § 539; 27 *Fairfield Maine R.*, 81, and after granting it to an individual, cannot divest his right, without compensation, by declaring it a highway. It has long been considered the law of *Pennsylvania*, that when the line of survey runs across streams of water and the owner of the land erected a mill dam on the stream, he could keep it up, without molestation, after the Legislature had declared the creek or river a public highway, and the owner could not be obliged to fit his dam for the passage of boats and rafts; but if done, it must be at the public

expense. Such owner might as well be required to remove bars, rocks or drift wood for the convenience of navigation, by virtue of the police power, as to fit up a dam so erected. The case has been likened to that of paving and side-walks in cities, or opening streets at the expense of lot owners; all of which has been sustained by our courts—See *Schenley vs. the City of Allegheny*, 1 Casey, 128; also 3 Watts, 592; or compelling a borough to pay more than its proportion towards the erection of a court house.—7 Harris, 258. But it must be borne in mind that in each of these cases the owner was benefited, or supposed to be, and therefore payment was lawfully enforced.

The Legislature professes, and has always exercised unlimited control over municipalities, and the citizens thereof who, by uniting with larger bodies, bring themselves and their property under management for the benefit of the whole. As we understand the police power of the State, which has been strongly pressed upon us as being unlimited and uncontrollable, and which no State can part with, it is nothing more than the authority to compel all owners of property to so use their own, as not to injure others; that, therefore, the State cannot, by contract or otherwise, part with the power to compel the owner of real estate so to use it as not to endanger the public health or safety. This is, perhaps, the extent to which writers on that subject press the doctrine.—See *Cooley's Const. Lim.*, 282-3. *Idem*, 276-7-8. But if it can be invoked for the purpose of enabling a State to revoke its grant, violate its contract, or take the property of an individual for public or private use, without making compensation, it is a most dangerous power, and enables the Legislature to do that which is expressly forbidden by the Constitution. Our only reason for examining the subject at such length is, that the authority has been strongly pressed, and it has been urged that the exercise of the power has never been presented to or commented on by the courts of our State on any of the decided cases. We are well aware that no law can properly be declared unconstitutional, unless it clearly violates the provisions of the organic law. But, as we understand this enactment, it takes the property of this corporation, defendant, for public use, without paying any equivalent, and clearly alters the character of the contract made with the railroad company at the time of the sale; in legal effect, violates the contract, and changes the charter of the company to which it sold; an act which transcends its power. It is very true that the present defendant was incorporated since the amendment of the Constitution, which gives the Legislature the power to change and modify the charters of incorporate companies at its pleasure; provided, in its opinion, no injustice will be done to the corporators. But, it will not be pretended that the Legislature, by the act of the 30th of March, 1866, undertook to construe or modify the charter of the Pennsylvania canal company, which had no legal existence at the time, but was incorporated on the 1st of May, 1866, and secured a transfer of the works from the railroad company on the 30th day of March, 1867. The whole act of Assembly, in relation to the passage of fish, is aimed at the railroad company, over the charter of which the Legislature had no control whatever.

We are aware that our decision will be a great disappointment to the people who ardently desire, and fully expected an ample supply of fish by the change of these dams. We are of the opinion that the alteration can be made if the same is deemed useful, but it must be done at the public expense; the defendant cannot be obliged to bear the burden. It is our duty to declare this act null and void, so far as it imposes on this company the

duty of changing the dams at its own proper cost; and we therefore render judgment in favor of the defendant on the special verdict.

JNO. J. PEARSON.
President Judge.

SPECIFICATIONS OF ERROR.

1. The court erred in directing judgment to be entered for defendant on the special verdict.
2. The court erred in not directing judgment to be entered for the Commonwealth on the special verdict.

ARGUMENT FOR THE COMMONWEALTH.

The facts of this case are so fully found in the special verdict, and so clearly stated in the opinion of the learned judge of the court below, that they need not be recapitulated before being used for the purpose of this argument.

The special verdict shows that the Pennsylvania railroad company, on the 31st day of July, 1857, received from the State a deed of conveyance of the public works, known as the Main Line, including the dam mentioned in the verdict, having become the purchaser thereof at the sale made in accordance with the provisions of the act of May 16, 1857.

The first question which arises in the case is, as we conceive, did the railroad company, by this purchase and deed, take the right to sell said works to the Pennsylvania canal company, the defendant in this case?

Before attempting to answer this question, it may not be out of place to state briefly, and in the language of this court, the well settled principles on which contracts between the State and individuals or corporations are construed by the courts. In the *Southwark railroad company vs. the city of Philadelphia*, 11 Wr., 323, Agnew, J., says: "Many of the cases were examined and the doctrine summed up by Justice Woodward in the *Iron City Bank vs. the city of Pittsburg*, 1 Wr., 340, wherein he states 'that a grant of land or of a corporate franchise by an act of legislation, is a contract between the State and the grantee, the obligation of which a subsequent legislature cannot impair.—P. 347.'"

"This being the admitted principle, it becomes a question of interpretation only, and the point is, what contract did the State make" with the Pennsylvania railroad company in this case, when she granted and sold to them the main line of the public works?

"Before solving this it is necessary to state the rule which must guide the interpretation in this case. It is one well settled in the courts of the United States and of this State. In the case of the *Charles River bridge vs. the Warren bridge*, 11 Peters, 544, Chief Justice Taney, following the language of an English decision, stated the rule to be 'that any ambiguity in the terms of the contract must operate against the adventurers and in favor of the public, and the plaintiff can claim nothing that is not clearly given them by the act.' In the *Susquehanna canal company vs. Wright*, 9 W. and S., 11, Chief Justice Gibson re-states the rule, as decided in the *Monongahela navigation company vs. Coon*, 6 W. and S., 113, to be 'that the State is never presumed to have parted with one of its franchises in the absence of conclusive proof of such an intention.'"

"Chief Justice Black afterwards stated the rule in these words: 'If anything is settled it is this rule of construction, that a corporation takes nothing by its charter except what is plainly, expressly and unequivocally

granted.'—*Bank of Pennsylvania vs. Commonwealth*, 7 H., 155. In the *Commonwealth vs. Erie and N. E. railway company*, this rule is still more strongly stated.—3 Casey, 359."

In accordance with this principle of interpretation it will certainly not be pretended that the right of the Pennsylvania railroad company to sell these works would be implied in the grant of them to be maintained and kept open as a public highway, as required in the act; unless there be an express grant of the right to sell it did not exist; and we submit that there is none such. It is true the third section of the act authorizes the purchasers, being individuals, to assign and transfer their right, after the sale, to the said main line, under said purchase, to any railroad or canal company then incorporated by the laws of this Commonwealth, but the provisions as to compliance with the terms of sale by such company clearly show that this meant a transfer of the right to the purchase before the execution of the deed. Again, in section five there is a proviso that "the purchasers may grant, sell, convey or lease any *part* or *portion* of said canals, and any corporation or association of individuals authorized by the act to purchase the whole may purchase or lease a part;" but this was evidently intended to enable the purchaser, after the sale, to convey or lease a *portion* of said canals to some one or more of the companies to whom the act gave permission to buy the whole at the sale, and could not be construed into a permission to sell the whole or even a part to a company not then in existence, and which had not authority to buy.

We conclude, therefore, that the railroad company had not, on the 30th day of March, 1866, the right to sell these works, at the least not to the defendants who were not then in existence. "Thus," in the language of the court below, "stood the rights to this feeder dam on the 30th day of March, 1866, when the act relating to the passage of fish in the Susquehanna was passed, under which the indictment in the present case was preferred." The railroad company at this date had the right to hold, keep up and maintain this dam and the rest of the work as a public highway forever, but had not the right to sell either, and these defendants had no right at all, not even the right to exist.

This act of March 30, 1866, entitled "An Act relating to the passage of fish in the Susquehanna river and certain of its tributaries," is a public general law, and requires every individual or corporation having or maintaining any dam, weir or other obstruction on the Susquehanna and its various branches, including the Juniata river, to maintain and keep up at each of said dams, weirs or other artificial obstructions, a sluice, weir or other device, for the free passage of fish and spawn up and down said stream, in such manner and on such plan as a commissioner, appointed by the Governor, may devise. Working plans are to be furnished by the commissioner, who is to inspect the dam immediately after the first of November next following; and if the device shall not have been constructed as prescribed, the commissioner is to report the delinquency to the district attorney of the proper county, who is to cause an indictment to be preferred against the delinquent corporation or individual.

After the passage of this act, namely: On the 1st day of May, 1866, the canal company, defendant in this case, was incorporated, and in the act incorporating it, authority was given it to buy, and to the railroad company to sell, said works, including this dam. The companies respectively accepted, and acted under the authority so given; and by virtue thereof the railroad company sold, and the defendants bought, said works. The defendants having so bought, and "having and maintaining" the dam, neglected or refused to make and keep up the passage for fish, required to be made and

kept up by said act, whereupon the steps pointed out by the law were taken, resulting in this indictment and special verdict.

The defendants claimed that to enforce this law against them would be to impair the obligation of the contract between the Commonwealth and the Pennsylvania railroad company, and that, therefore, as to them the law was unconstitutional and void, and the court below so decided.

This court will see from the opinion, that the learned judge treated the case as though it were a question between the Commonwealth and the railroad company. In this we think there was manifest error. The rights of the railroad company were not involved, there was no charge against them, they were not parties to the case, nor liable over to defendants, nor could they be in any way affected by the verdict and judgment. But the ground of the claim seems to be, that as the railroad company bought from the State, without being subject to any burden or reservation as to the altering of the dam, and the canal company purchased from them, they also took with an immunity from the imposition of any burden, and that they succeeded to the contract between the State and the railroad company as it stood in 1857.

Conceding for the present that the railroad company, if they had continued to hold the works, could not have been forced to comply with this law, we think it by no means follows that the canal company can plead the same immunity. All the former company had, as we have already seen, was a right to hold and a duty to keep open the works; this was the extent of their contract with the State. When, subsequently, the additional privilege of selling was granted, the Legislature had the right to impose upon that privilege any burden they saw fit, and they did impose, by the prior law, on which the indictment in this case is founded, upon the right to sell and upon the power to buy, the burden and duty to be performed by the purchaser, of making a passage for the fish in the dam. The rights acquired under the original contract with the State are not affected by this act. The railroad company was not bound to accept the privilege of selling, but when they did, they accepted it subject to the law as it then stood.

And this appears still more clearly when we view it in relation to the defendants. They were not in existence when the act under which they are indicted was passed; they had no rights; the grant to them of the right to purchase, as well as to exist, came afterwards, and they surely cannot complain of any burden being imposed upon them, when they were entirely free to accept the grant with its privileges and burdens, or to decline it altogether. This only they could not do: accept the privileges and decline the burdens.

These principles seem to have been decided by the Supreme Court of the United States in the case of *Armstrong vs. The Treasurer of Athens county*, 16 Peters, 281. In 1804 lands set apart by Congress for a university in Ohio, were vested in a corporation with power to lease the lands at certain rents, and to increase the rents, from time to time, to the amount of any taxes imposed on any similar property, and declaring that the lands should forever be exempt from all State taxes. In 1826 the corporation was authorized to sell the lands, nothing being said in regard to taxes in the act authorizing the sale, yet the United States Supreme Court held that the lands in the hands of purchasers were not exempt from taxation by the State. The court say: "The purchasers had no connection or privity with the act of 1804, they could claim only by force of the act of 1826, authorizing the corporation to sell;" and they distinguish this case from the earlier one of *New Jersey vs. Wilson*, 7 Cranch, 164, which decides that certain lands which had been granted to the Stockbridge Indians, free from

taxation, could not be taxed in the hands of purchasers from the Indians. The court say in that case that the State of New Jersey might have insisted on the surrender of the privilege of exemption from taxation as a sole condition on which a sale of the property should be allowed, but not having done so, and it being for the benefit of the Indians because of its enhancing the value of the land, the court held that this exemption ran with the land.

In this case we submit that the State, by the passage of the act of March 30, 1866, did insist that the privilege of holding this dam free from legislative control should be surrendered as a condition of the grant of the power to the railroad company to sell; and that the canal company can claim only under its charter granted subsequent to, and therefore subject to the act of March 30, 1866.

We do not know that it is necessary, yet we recite a few cases to show that corporations are subject to the provisions of general laws in force at the time they obtain their charters.—*Pratt vs. the Atlantic and St. Lawrence R. R. Co.*, 42 Me., 579; *Bowen vs. Sears*, 5 Hill, 221; *Bank vs. Nolan*, 7 Howard, (Miss.) 508; *Bank vs. Archer*, 8 Smedes and M., 151; *Coffin vs. Rich*, 45 Me., 507.

And to the general laws passed subsequently, if they do not conflict with the clearly expressed or necessarily implied provisions of their charter.—*Easton bank vs. The Commonwealth*, 10 Barr, 442; *Providence Bank vs. Billings*, 4 P., 514; *Iron City Bank vs. The City of Pittsburg*, 1 Wr., 340; *Norris vs. Andruscroggin Railway*, 39 Me., 293; *Railway vs. Smith*, 37 Me., 35; *English vs. N. H. and Northampton Co.*, 32 Conn., 240.

When damage had been done by the erection of a dam by a corporation, for which they were not liable under their charter, which contained no reservation of power to alter and amend, and afterwards the corporation accepted a supplement containing such reservation, they were held bound by a subsequent act requiring them to pay for damages previously done.—*Monongahela Nav. Co. vs. Coon*, 6 Barr, 379. *

Applying, then, the settled principle of the strict construction of grants and charters from the State to the charter of the canal company defendants, we contend that they took their charter subject to the provisions of the general law, on which the indictment in this case is based, which had been previously enacted, and was in full force at the time defendants acquired their charter; and that there is nothing in its provisions which impair the obligation of any contract between them and the State or between them and the railroad company. They took the right to exist and to purchase these works subject to the duty imposed by a previous general law, upon whomsoever should maintain any dam in the Susquehanna river, to construct thereon a passage for fish, as described in the act; and having voluntarily taken the privileges granted them by law, they cannot complain of the burdens annexed to these privileges.

The principle that corporations take their charters and grants from the State, subject to the provisions of existing laws, is a necessary deduction from the settled meaning of the term "obligation," as used in the Constitution. "The obligation of a contract consists in its binding force on the party who makes it, and this depends upon the laws in existence when it is made; these are necessarily referred to in all contracts, and form a part of them as the measure of the obligation to perform them by the one party and the right acquired by the other."—*Cracken vs. Hayward*, 2 Howar 612; *Ogden vs. Sanders*, 12 Wheaton, 259; See opinions of Washington, Thompson and Trimble, J. J., in this case. Also *Pomeroy's Const. Law*, pp. 382-8; *Cooley's Const. Law*, pp. 285-6.

“The law must have a present effect upon some contract in existence, to bring it within the plain meaning of the language employed. There would be no propriety in saying that a law impaired, or in any manner whatever, modified or altered what did not exist. The most obvious and natural application of the words themselves, is to laws having a retrospective operation upon existing contracts; and this construction is fortified by the associate prohibitions: ‘No State shall pass any bill of attainder, *ex post facto* law or law impairing the obligation of contracts.’ The first two are confessedly restricted to retrospective laws, * * * and no good reason is perceived why the last should not be. No one supposes that a State Legislature is under any restriction in declaring, prospectively, any acts criminal which its own wisdom and policy may deem expedient. And why not apply the same rule of construction and operation to the other provision relating to the rights of property?”—Johnson, J., *Ogden vs. Sanders*, 12 Wheaton, 303.

“There is (as stated by Black, C. J., in *Sharpless vs. Mayor of Philadelphia*, 9 H., 164) another rule which must govern us in cases like this, viz: ‘That we can declare an act of Assembly void only when it violates the Constitution *clearly, palpably, plainly* and in such manner as to leave *no doubt* or hesitation on our minds. This principle is asserted by judges of every grade, both in the Federal and in the State courts; and by some of them it is expressed with much solemnity of language.’—6 Cranch, 87; 4 Dallas, 14; 3 S. and R., 178; 12 S. and R., 339; 4 Binney, 123. A citation of all the authorities which establish it would include nearly every case in which a question of constitutional law has arisen. I believe it has the singular advantage of not being opposed even by a *dictum*.”

And in determining whether an act of the Legislature is constitutional or not the court must look to the body of the Constitution itself for reasons. The general principles of justice, liberty and right not contained or expressed in that instrument are no proper elements of a judicial decision upon it.—*Ibid*.

But it is contended, by the defendants, that to compel them to obey this law would amount to a taking of their private property for public purposes without compensation. To this we answer, in the first place, that their property is not “*taken*,” they are not “*deprived*” of it. The meaning of the Constitution, on this point, has been settled; and it has been universally interpreted to be “a taking altogether, a seizure, a direct appropriation, dispossession of the owner.”—*Sharpless vs. The Mayor*, 9 H., 166-7, and cases cited. And in the next place, if it be claimed that the money which it would cost to construct the passage for the fish is taken, we answer that this is part of the price which the defendants pay for the works; they took them by permission of the State, subject to the condition that they would construct the fish-way, and it is part of the obligation of their contract with the State, which they are bound to fulfil. Moreover money can never be the subject of “*taking*,” in the constitutional sense, because, if taken, it must be with compensation, which could only be made by returning the exact sum taken, and this would render the taking a nullity.

We respectfully submit that the case of the *City of Erie vs. the Erie canal company*, 9 P. F. S., 174, does not, as will no doubt be contended by the defendants in error, at all conflict with our view of this case. That ruling is based upon the fact stated by Justice Sharswood, in delivering the opinion of the court, that “in the act incorporating the Erie canal company there was no power reserved to the State to alter or modify its provisions;” hence, the Legislature could not do this by a law passed subsequently. But in this case the law claimed to be enforced was passed prior to the act of

incorporation of the canal company, and as we contend they took their franchises, including their *right* to buy, as well as the property purchased subject to the prior law. If we are correct in this, that case has no bearing on this question.

We are aware that the fifth section of the act to incorporate the Pennsylvania canal company provides, that "all acts or parts of acts of the General Assembly of the Commonwealth, inconsistent herewith, be and the same are hereby repealed." But we do not think it can be successfully claimed that the act of March 30, 1866, is "inconsistent" with the act chartering the canal company, or that a general public act would be repealed by a private act in this indirect manner.

The *People vs. Platt*, 17 Johns R., 195, is an authority in our favor. The court base their decision in that case entirely on the fact that the river Saranac is not navigable, and that it was the private property of the defendant Platt, "as high up as salmon ascend." Spencer, C. J., says, p. 215: "I am sensible that the Legislature has passed many laws regulating the slope of dams to facilitate the passage of fish; but what are the particular circumstances of the rivers, in regard to which these laws were enacted, I am uninformed; *it may be that they are navigable for boats, and then no objection could be made to such acts.* In the present case the river Saranac is not capable of being used as a passage way for boats or water craft of any kind. It has been granted and thus has become *private property* as high up as salmon ascend. *The fishery itself* has passed by these grants." The right of fishing for salmon in this stream being vested exclusively in the defendant as far up the stream as the salmon ever went, neither the public nor any individual had any right above his dam; necessarily the judgment must be for him.—See *Gentile vs. The State*, 29 Ind., 409.

The case of *Crenshaw vs. Slate River company*, 6 Randolph, 245, cited and relied on by the court below, we do not think analogous. It was an attempt to force a private citizen, at his own expense, to make and keep up an artificial navigation on a stream which had never been navigable, and the bed of which was his own private property. This appears from the opinion of Justice Coulter, pp. 281-2. He says: "This case simply presents the question, whether the owner of a mill can be thus disturbed, he having erected the mill under an order of court, duly granted in the year 1802, to him who holds under a patent of a very early date granting the land, not bounded by the stream of water, but running across it so as to convey it, water and all, so far as such a patent can convey the public right to the water, of a stream, too, on which there never was any ordinary navigation, and on which, particularly at this place, *extraordinary* navigation cannot exist, without the aid of dams of some kind, and perhaps of the very kind of that now erected, and in which the claim of the public to this extraordinary navigation has been asserted long after the mill was so erected." In other words, the stream was not navigable at all without the dam; the defendant in this case had built the dam and thus created the navigation, and the law attempted to require him, in addition, to make and maintain a lock in his dam, that the public might be able to use the navigation thus created by him, and the court very properly decided that this could not be done.

The case of the *Washington bridge company vs. The State*, 18 Conn. R., 53, is clearly distinguishable from this case. "That was," says Church, J., delivering the opinion of the court, "an information or writ of *quo warranto* presented by the State's Attorney against the Washington bridge company, not prosecuted on the ground that the defendant's bridge is a public nuisance, obstructing the common and free use of the Housatonic river as

a navigable stream; but the point of grievance complained of is, that the company have disregarded a resolution of the General Assembly of May, 1845, and have thereby forfeited their chartered rights." This brought the case directly within the protection of the Constitution against impairing the obligation of contracts. The law was aimed directly at the very essence of the contract of the company with the State; that they should have a corporate existence and franchise; and it attempted to deprive them of this, not because they obstructed navigation which was not pretended, but because they did not increase the draw of their bridge from thirty-two to fifty feet, in obedience to a resolution of the General Assembly.

But we contend that the act of March 30, 1866, is constitutional, and hence that the judgment of the court below in this case should be reversed on another ground; that the passage and enforcement of it is a proper and legitimate exercise of what is usually styled the police power of the State, which is thus defined by C. J. Redfield, in *Thorpe vs. Rutland and Burlington R. R. Co.*, 27 Vt., 149: "This police power of the State extends to the protection of the lives, limbs, health, comfort and quiet of all persons, and the protection of all property within the State according to the maxim *Sic utere tuo ut alienum non laedas*; which being of universal application, it must, of course, be within the range of legislative action to define the mode and manner in which every one may so use his own as not to injure others." By this "general police power of the States, persons and property are subjected to all kinds of restraints and burdens, in order to secure the general comfort, health and prosperity of the people of the State, of the perfect right in the Legislature to do which no question ever was, or upon acknowledged general principles ever can be made, so far as natural persons are concerned." And it was said by this court in *Railway Co., vs. Gilliland*, 6 P. F. S., 452, that "Corporations as well as individuals, by the principles of the common law, are bound so to exercise their rights as not to injure others. The principle *Sic utere tuo ut alienum non laedas* is of universal application." We respectfully submit that the right of free fishery, which is vested in all the inhabitants of the State, is a right of such importance and value to the health and prosperity of the citizens of the State at large, as to bring it within the class of rights which may be defined and protected by this police power. The right to fish in such rivers as the Susquehanna and Delaware belongs to the public.—*Carson vs. Blazer*, 2 Binney, 475; *Shrunk vs. Navigation company*, 14 S. and R., 71. It is subject to be regulated by the State on this principle; *Moulton vs. Sibley*, 37 Maine, 472; *Denham vs. Lamphen*, 3 Gray, 268. This has been done from the earliest times down to the present in this State; *Hart vs. Hill*, 1 Wharton, 132. And in many of the other States; *Angell on Water Courses*, (6 Ed.,) sect. 86.

In the case of the *Commonwealth vs. Tewksbury*, 11 Metc., 55, the court held that a statute which imposed a penalty on "any person who shall take, carry away or remove any stones, gravel or sand from any of the beaches in the town of Chelsea," passed for the purpose of protecting the harbor of Boston, extended as well to the owners of the soil as to the strangers, and was not such a taking of private property for public use as to render the act unconstitutional, though no compensation was provided for the owners.—*Shaw, C. J.*, says: "All property is acquired and held under the tacit condition that it shall not be so used as to injure the equal rights of others, or to destroy or greatly impair the public rights and interests of the community under the maxim of the common law—*Sic utere tuo ut alienum non laedas*."

So in *Coates vs. The Mayor*, 7 Cowen, 585, it was decided: That though

the city had granted certain premises for the express purpose of interment of the dead, a by-law, passed under authority granted by the Legislature, prohibiting such interment without providing compensation, was constitutional, and could be enforced. And this, though the city had given a covenant for quiet enjoyment to the owner.—*Brick Church vs. The Mayor*, 5 Cowen, 538. So it has been held in numerous cases, that the Legislature have the constitutional right to require existing railroad corporations to fence their track, and to make them liable for all beasts of burden killed by going upon it. *Thorpe vs. Rutland and Burlington R. R. Co.*, 27 Vt., 156, and many other cases cited in *Cooley's Const. and Stat. Limitations*, p. 579, 580.

The States, in the exercise of their police power and for the general good, may pass laws which if based on any other ground would be repugnant to the Constitution of the United States and the laws of Congress passed by its authority.—See *Gilman vs. Philadelphia*, 3 Wallace, 730; and see remarks of Clifford, J., p. 743; *Cooley's Const. and Stat. Limitations*, 584 to 597.

It was contended by defendants in the court below, that the act under which they were indicted had been repealed by the act of April 13, 1867, continuing in force the provisions of the second section of the act of March 13, 1866. The argument is, that as the second section was re-enacted, having expired by the limitation contained in it, the other sections, which were not limited, were repealed. The learned judge of the court below has so fully and clearly answered this position, as well as the contention that the law is *ex post facto* in its operation against defendants, that we are satisfied to rest these points on what he has said, with the single additional remark, already made in another connection, that the law was passed before defendants came into existence.

F. CARROLL BREWSTER,
Attorney General.
J. W. SIMONTON,
ROB'T L. MUENCH,
Counsel for Plaintiff in Error.

COUNTER STATEMENT OF DEFENDANT IN ERROR.

There were two indictments in the quarter sessions of Dauphin county, on which true bills were found on November 21, 1867.

The charge in each case was for alleged nuisance. The indictments were Nos. 36 and 37, November sessions, 1867. The first being against the Pennsylvania railroad company, and the second against the Pennsylvania canal company. The charge in each case was that the defendants were guilty of a nuisance, in neglecting to alter the dam over the Swatara creek where it empties into the Susquehanna river, in one instance; and in neglecting to change the dam at Clark's Ferry, in the other, in compliance with the provisions of the act of March 30, 1866, "relating to the passage of fish in the Susquehanna river and certain of its tributaries." On the 25th of January, 1868, a jury were called and sworn in both cases, who found a special verdict, printed in the paper book of plaintiff in error. The questions presented on this special verdict were argued before the court below, on the 3d Monday of December, 1868, at which time a judgment for the Commonwealth was not pressed against the railroad company. It was admitted that the company held the dam free from legislative control, and

that it was not subject to the alleged charge of nuisance, for failure to comply with the terms of the act of March 30, 1866, which imposed new burdens, not part of the contract with the State under the terms of the act "for the sale of the main line of the public works." The case against the railroad company being abandoned, the opinion of the court was filed on the 15th February, 1869, in the proceeding against the canal company, and the same day judgment was entered on the verdict in favor of the defendant in that case.

The history of the case as given by the plaintiff in error is erroneous, in stating that the law of May 16, 1857, for the sale of the main line, "gave no authority to the railroad company, which became the purchaser, to sell the works."

The third and fifth sections of that law expressly confer the authority on the purchaser to sell the whole, or any part, of the canals.

The history of the case is defective, also, in omitting all reference to the act of 13th April, 1867, which is a supplement to the act of 30th March, 1866, and limits the duration of the second section of the latter to the 31st of December, 1867.

BRIEF ARGUMENT FOR DEFENDANT IN ERROR.

1. It is now claimed by the council for the plaintiff in error, that the learned judge of the court below erred in treating this case as though it were a question between the Commonwealth and the railroad company. Conceding that the railroad company could have continued to hold the works without being subject to the provisions of the act of March, 1866, they argue that it does not follow that the canal company can plead the same immunity, because the latter company purchased the canal from the former after the passage of the law imposing the burdens, and further, because the canal company was not in existence when the act under which it is indicted was passed. We think the plain reading of the "act relating to the passage of fish in the Susquehanna river" settles this case beyond all controversy. It is clear that the Pennsylvania canal company, incorporated as it was after the passage of that statute, is not embraced within the corporations mentioned in the act, and that no proceeding can be maintained against it for violating a law which it was not bound to observe. It is a fundamental principle that no person or corporation can be compelled to do what the law does not require. The nature of legislative power limits the exercise of it. All statutes not of doubtful meaning are to be construed from the words used. All penal statutes are to be strictly construed. Let us see what this highly penal statute of March 30, 1866, says:

"That it shall be the duty of such person or persons, corporation or corporations, having and maintaining any dam or dams, weir or weirs, or artificial obstructions of what kind soever, now constructed, or which may have and maintain dams, weirs, et cetera, as aforesaid, which may hereafter be constructed on the Susquehanna river, to make, maintain, &c." The quotation just referred to follows the enacting clause, and enumerates the persons or corporations which the act was aimed at. All the other references of the act refer to this part of the first section as describing the "persons, companies and corporations" embraced within it. The defendant was not in existence at the date of the passage of the act. It neither had nor maintained "any dam or dams, weir or weirs, or other artificial obstruction," because it was not in existence. It did not purchase the canal with its appurtenances until just one year after the passage of the act under which these burdens are said to be imposed. It is not charged

in the indictment stated in the special verdict, neither was it pretended on the argument of the case in the court below, that the defendant constructed any dam, weir or other artificial obstruction on the Susquehanna river, at Clark's Ferry, after 30th of March, 1867, or after the passage of the act of the 30th of March, 1866. If it did not maintain the said dam at the time of the passage of that act, and if it has not constructed it since, is it embraced within the terms of the statute? We respectfully submit that it is not. While we have full faith that this is the proper construction of the act referred to, and that the court of last resort will so say, as the case involves the existence of the canal, we will briefly submit our views, and the authority upon which we rely, on the other questions raised in the case.

2. It is submitted that even if this view is wrong as to the persons or corporations embraced within the letter and spirit of the act of March, 1866, that that statute is no longer in force, and was not at the time judgment was entered in this case, by reason of the passage of the act of 13th April, 1867, which provides, "That the several provisions of the second section of the act, entitled 'An Act relating to the passage of fish in the Susquehanna river and certain of its tributaries,' approved March 30, 1866, be and the same are hereby continued to the 31st day of December, 1867." The second section of the act of 1866 is the vital part of it, and that on which the prosecution in this case is based. The act of 1866 having thus expired by the limitation fixed in the act of 1867, no further proceedings could be had thereunder. Assuming that the act had expired, this position is conceded by the court below, in the opinion filed.—Road in Hatfield township, 4 Y., 392; United States vs. Passmore, 1 W. C. C. R., page 84; 4th Dallas, 372; North Canal street road, 10th Watts, 351; Stæver vs. Immel, 1st Watts, 258; Commonwealth vs. Duane, 1st Binn., 601, &c.; Commonwealth vs. King, *et al.*, 1st Whar., 448 and 460; Hastings vs. The People, 8 Smith (N. Y.) Rep., 95, 106, 107.

3. It is further contended that the act of 1866 is an *ex post facto* law, and for that reason unconstitutional. It makes that a criminal offence, and indictable as such, which when originally done was no offence at all. The dam was constructed by the State in 1826, more than forty years before the finding of the indictment, and for aught that appears, and as matter of fact, has remained substantially in the same condition ever since.

4. The act of March 30, 1866, impairs the obligation of a contract by imposing obligations different from those contained in the original contract without defendant's consent. The Pennsylvania railroad company was a corporation created under a law of this State, and purchased the main line of the public works, including the dam mentioned in the verdict, on the 31st of July, 1857, under the provisions of the act of May 16, of that year.

This act was a contract between the State and the railroad company, by which it and its *successors and assigns* acquired the entire right of the State to the main line and all its appurtenances. It expressly authorized the purchaser "to grant, *sell and convey*, or to lease for a term of years, upon such conditions as may be agreed upon, *any part or portion of said canal*, and any corporation or association of individuals authorized by this act to purchase the whole, may *purchase* or lease such portions and hold the same, subject to the conditions, and entitled to all the privileges contained in this act." And in the third section it is declared "that it shall be lawful for any person or persons, or railroad or canal company now incorporated, or which may hereafter be incorporated by and under the laws of this Commonwealth, to become the purchasers of the said main line and public works."

So much, and only so much, in answer to the labored argument of the learned counsel for the plaintiff in error, that the canal company had no right to purchase, and the railroad company no right to sell, save under the act incorporating the former.

It being apparent, therefore, that the railroad company had the right to sell to the canal company, and actually did sell, the latter thereby acquired all the rights possessed by the former under the act of 16th of May, 1857.

The act of May 1, 1866, incorporating the Pennsylvania canal company, provided that in case of a purchase of the canal from the Pennsylvania railroad company, it should take it "with all the powers, privileges and franchises granted, or intended to be granted, and subject to all the requirements and conditions of the act of May 16, 1857, under which the Pennsylvania railroad company purchased the public works, so far as the same were applicable to and for the uses and purposes of the canal." The act further provides "that the canal company, in case of a purchase, should be required to keep said canal in good, navigable condition during the season of navigation."

Substantially the same duty was imposed on the railroad company by the fifth section of the act of 1857.

It is plain, therefore, from these statutory provisions, that the canal company assumed the same duties and responsibilities as the railroad company, and no others.

"A railroad company is a private corporation, whose charter is a contract between it and the State, not subject to alteration by the latter, so as to deprive the company of the rights secured by the charter."—Pierce on Am. R. R. Law, 20; *Mogon. Nav. Co. vs. Coon et al.*, 6 Barr, 381; *Erie and North-East. R. R. vs. Casey*, 1 Grant, 275, 287, 301; *Commonwealth, ex rel., Claghorn et al. vs. Cullen et al.*, 1 Harris, 133, 168 and 139; *Brown vs. Hummel*, 6 Barr, 86; *Terret et al. vs. Taylor et al.*, 9 Cranch, 43; *Calder vs. Bull*, 3 Dallas, 386, 388 and 389.

And this same doctrine is abundantly confirmed by this court, in the recent case of the city of Erie vs. the Erie canal company, 9 P. F. Smith, 174.

Treating the charter as it then stood, it was a contract which cannot be changed by one party imposing new duties and new penalties for the non-performance, and interfering with the rights acquired under it, without consent of the other. It needs but the slightest reference to the act of March, 1866, to show that new burdens are imposed by it. It requires the owner of the canal to change all its dams, including the one in controversy. These are twenty-six in number, and it was a fact not questioned in the argument of the case, that the expense of making the alterations would amount to over two hundred thousand dollars, independent of the cost of keeping them in repair. The alterations are required to be made as directed by an officer of the State, and not of the canal company. He is the sole judge of how the work should be done. What the effect of the alterations might be on the canal he would neither know or care. If the work is not done according to the plans furnished, the company is to be indicted for maintaining a public nuisance, and when convicted, fined not more than twenty thousand dollars, and if that admonition to furnish shad to the public at the company's expense be not regarded, by compliance within thirty days thereafter, the sheriff is to take down the dam at the company's expense, and to collect the cost by sale of any of their property—even their corporate rights and franchises. The act really transfers the whole question of repairs, after the work is done, what are necessary and when they shall be made, from the officers of the corporation to the commissioners of the several counties in which the dams are situated. The law of 1857 re.

quires the canal to be kept in good repair and operating condition. The railroad company is held responsible for damages if it is not; and the same duty and liability are imposed on the canal company. How can this duty be discharged, or with what justice can they be held responsible, if the discretion and power of doing the work in the first instance, and of making repairs afterwards, are taken from them and they are to become dependent for the privilege of touching these sluices or weirs, upon the whims of men elected without any reference to their knowledge of canals, and totally irresponsible for their condition. This Clark's Ferry dam feeds the canal for a distance of over forty miles, any injury to it would be an injury to the canal. If it goes down that portion of the canal will go down with it. To keep it up to supply sufficient water to the canal, at certain seasons of the year, requires work, vigilance and skill. While this dam was owned by the State, and since that time, there is not usually any more water than is required to keep the canal in "operating condition" during summer months. To maintain navigation at all during this time, it is necessary to close the schute of the dam and put splash boards on the top of it, that the water may be kept at sufficient height to feed this portion of the canal. Our statute books are filled with laws recognizing these facts, and appropriating money to do annually the necessary work, while the State owned the public improvements. If the comb of this dam is cut down, as would be required in making the alteration, and if the same thing was required to be done to each of the other dams along the line of this canal, it would be utterly impossible to keep the canal in "good operating condition," or in any condition at all suitable for purposes of navigation. To keep up the canal the dams must be maintained, but if the county commissioners decide that repairs are not necessary, then, despite the opinions of engineers or directors, the owners of the canal cannot touch that portion of their works. The Clark's Ferry dam was erected by the State and transferred, in its present condition, to the railroad company, without any superadded obligation, and so the present company hold it. But now, more than twelve years after the purchase, because a subsequently imposed duty is not performed, the dam, lawfully placed there by the State, is declared, by the State that put it there for a public benefit, to be a public nuisance, and it is directed to be removed as such. The consequence of this removal would be to render impossible, on part of the company, the previously imposed and contract duty of keeping up the canal. If the company comply with the terms of the act, and alter the dams, it would be at frightful expense, besides which the alterations would ruin the canal. If it refuses to comply, and the law can be enforced, the twenty-six dams would be taken out by legal authority, the canal rendered utterly worthless; the obligations of the law of 1857, imposed for the public good, would be wiped out by the penalties of the act of 1866, and the whole property of the canal company destroyed, without one cent of compensation.

5th. The act of 30th March, 1866, is unconstitutional, also, because it takes private property for public use, without compensation to the owner. This elementary principle is so well settled by judicial decision and so ably stated in the opinion of the court below, that only a few additional authorities need be cited.

"It is laid down by jurists as an acknowledged principle of universal law, that a provision for compensation is a necessary attendant upon the due exercise of the power of the law given to deprive an individual of his property without his consent."—Angel on Water Courses, secs. 457-8-9, &c.

To the same effect also Red. on R. R., 555-6; Pierce on Am. R. R. L., 38; 2 Kent's Com., 408-9; Cranshaw vs. The Slate River Co., 6 Rand.

important constitutional and legal questions involved in this case. That opinion is in entire accordance with our own views, and we adopt it as the opinion of this court.

It is strongly urged, however, on behalf of the Commonwealth, and this has been the principal contention here, that he fell into a fundamental error, which vitiated all his reasoning, by treating the case as though it were a question between the Commonwealth and the Pennsylvania railroad company, who were the original purchasers of the dam at Duncan's island, together with the other public works under the provisions of the act of Assembly passed May 16, 1857, (Pamph. Laws, 519,) entitled "An Act for the sale of the main line of the public works." It is apparently conceded that the Pennsylvania railroad company took the works under that act by contract, and paid for them to the State a valuable consideration, and that consequently the State could not impose upon their grantee any new burthen not contained in the original sale; for that would be for one of the parties to add a new term or condition to the contract. In that respect the case is stronger than the City of Erie vs. the Erie canal company, 9 P. F. Smith, 174—for the Erie canal company was the donee, rather than the vendee of the Commonwealth. But it is said that by the act of 1857 the Pennsylvania railroad company were not authorized to sell any part of the works to the Pennsylvania canal company; because at the time of the original sale of the whole it was not then an existing corporation, and consequently when the last named company was incorporated by the act of May 1, 1866, (Pamph. Laws, 1068,) and were thereby authorized and empowered to purchase, take and hold from the Pennsylvania railroad company, and which said railroad company were thereby authorized and empowered to grant, the canal from Columbia to the junction at Duncan's island, etc., with all the property and appurtenances thereto appertaining, they necessarily took the same under and subject to the provisions of the previous act of Assembly of March 30, 1866, (Pamph. Laws, 370,) entitled "An Act relating to the passage of fish in the Susquehanna river and certain of its tributaries," for a violation of which this indictment was preferred. The argument has great ingenuity and plausibility, and if its premises be admitted the conclusion would seem to follow logically and inevitably. All legislative acts alienating public rights or domain are to be strictly construed, and no such grant is to be inferred by implication merely. Accepting this as not only the well established but sound and reasonable canon of construction, let us examine how it applies in the case before us; whether there is not here a sufficient actual expression to be beyond the reach of the rule. By the third section of the act of 1857 it was provided "that it shall be lawful for any person or persons, or railroad or canal company, now incorporated, or which may hereafter be incorporated, by and under the laws of this Commonwealth, to become the purchasers of the said main line of the public works." Then, after various provisions, applicable specially and severally in case an individual or an association of individuals, or the Pennsylvania railroad company should become the purchasers; and directing, in the fifth section, that immediately after the said purchaser or purchasers, or their assigns, shall take possession of the same, the said purchaser or purchasers, or assigns, shall be bound ever thereafter to keep in good repair and operating condition the main line of said railroad and canal, extending from Hollidaysburg to Philadelphia, etc. It is added in these words: "Provided, That said purchasers be authorized to grant, sell and convey, or to lease for a term of years, upon such conditions as may be agreed upon, any part or portion of said canals, and any corporation or association of individuals authorized by this act to purchase the

whole, may purchase or lease such portions and hold the same subject to the conditions and entitled to all privileges contained in this act." As, by the third section, any corporation thereafter to be incorporated and entitled to become purchasers of the whole it would seem, at first blush, to follow by express words that such corporations would also be authorized to become sub-purchasers or lessees of part. But it is maintained, and here is the stress of the argument, that by the third section it was only meant that corporations, which should be incorporated between the date of the act and the sale, should become purchasers; for how, in the nature of things, it is asked, could a corporation purchase which was not in existence at the time of the sale? By a necessary inference, a corporation not in existence at the time of the sale could not become a purchaser of a part under the fifth section. The argument is more refined than solid. We must bear in mind that the established canon of construction is that *verba relata non maxime operantur per referentiam ut in eis in esse videntur*, 1 Just., 159, a. If, in pursuance of this rule, we transfer the words of the third to the fifth section, they must then receive the same construction which it is conceded that they have in the third section, so as to authorize a sale to any corporation created after the passage of the act and before the sale or lease mentioned in the fifth section. That this was really the mind of the Legislature can hardly be matter of doubt with any one who reflects upon the circumstances of the case. That body cannot fail to have perceived that the only really practicable mode by which a sub-sale or lease of parts of a work of that character was likely to be effected would be by some corporation especially to be created for the purpose, just as they evidently did see the same thing in the provision made for the original sale of the whole. It was highly improbable that any corporation existing at the time of the original sale could, consistently with its charter, unless incorporated expressly for the purpose, become a sub-purchaser or lessee of part. It follows that the Pennsylvania canal company, incorporated May 1, 1866, and specially authorized, as we have seen, to purchase from the Pennsylvania railroad company, became their assignees under and by virtue of the original power to sell contained in the act of 1857, and of course took the subject of the grant in its words with all the privileges thereby conferred upon them. Nay, the terms of the act of incorporation, May 1, 1866, seem intended to leave no possible doubt upon this point, for it declares that they shall be vested "with all the powers, privileges and franchises granted or intended to be granted" to the Pennsylvania railroad company. And this is again repeated: "And the said Pennsylvania canal company, their successors and assigns, be and they are hereby vested with the said powers, privileges and franchises." They became, thereby, the assignees of the Pennsylvania railroad company, and stood in their shoes to all intents and purposes as parties to the contract authorized by the act of 1857. The learned president below, therefore, fell into no error in treating the case as though it was a question between the Commonwealth and the Pennsylvania railroad company.

The franchises conferred upon the Pennsylvania railroad company, and vested in the Pennsylvania canal company, as their assigns, on this great public highway, are undoubtedly still within the right of eminent domain of the State, and may be resumed or taken under the limitation of Art. IX, Sect. 10, of the Constitution, "nor shall any man's property be taken or applied to public use without the consent of his representatives and without just compensation being made."—*West River bridge company vs. Dix*, 6 Howard (U. S.) Rep., 507; *Commonwealth vs. Pittsburg and Connelleville railroad company*, 8 P. F. Smith, 50. Judgment affirmed.

MASSACHUSETTS—THE CASE OF THE HOLYOKE DAM, AT HADLEY FALLS, ON THE CONNECTICUT.

The Holyoke water-power company had for object the erection of a dam twenty-eight feet high, on the Connecticut, for creating a water-power for great mills. First the corporation applied to the "general court" for a charter. In this charter permission was given to build a dam, *provided*, the owners of fisheries *above* the dam were indemnified. That was all; nothing said *pro* or *con* about a fish-way. The corporation put up their dam *without* a fish-way, and so it stood for a score of years. Now, then, the "common law" of Massachusetts (ancient charter law, presumably) says that fish-ways shall be provided in dams. So the fish commissioners go to the Holyoke company and order the fish-way to be made, alleging that the company came under the provisions of the said "common law." The charter grants no exemption from a fish-way, and charters are to be construed *against* the grantees and other reasons. The corporation refused; was brought before court, and the case was decided in favor of the Commonwealth.

The corporation has appealed to the Federal courts. Some scraps of Massachusetts law are appended, which go toward an elucidation of the case. But it will be minutely reported in the report of the Massachusetts fish commissioners for the current year.

ANCIENT CHARTERS.

[Page, 148, Chap. 63.]

2. All householders have free fishing in any great ponds, bays, coves and rivers, so far as the sea ebbs and flows within their own town, unless free-men of said town or general court have otherwise appropriated them: *Provided*, That no town shall appropriate to any persons any great pond, containing above ten acres of land, and that no man shall come upon another's land without their leave otherwise than as hereafter expressed.

3. It is declared that in all creeks, coves and other places about and upon salt water, where the sea ebbs and flows, the proprietor of the land adjoining shall have propriety to the low-water mark, where the sea doth not ebb more than one hundred rods, and not more wheresoever it ebbs further: *Provided*, That such proprietor shall not, by this liberty, have power to stop or hinder the passage of boats or other vessels in or through any sea, creeks or coves, to other men's houses or lands.

4. And for great ponds, lying in common, though within the bounds of some town, it shall be free for any man to fish and fowl there, and may pass and re-pass on foot, through any man's propriety for that end, so they trespass not upon any man's corn or meadow.

ABSTRACT OF PRINCIPAL DECISIONS.—MASS.

[1641, 47.]

As to fishing, &c., in tide-waters, it seems to have been intended to restrict the right to householders in the town where the waters were. But this part of the ordinance is not at all regarded in practice, and probably never was intended to apply to the common law right of every citizen in those waters. Otherwise as to ponds, it is believed that great ponds, that is, of more than ten acres, have in many instances become private property. "*But whether the owners can restrain all other persons from fishing therein is not known to have been decided.*"—*Metcalf on Contracts*, p. 299.

This statement of Judge Metcalf is the latest authority on the rights of riparian owners of great ponds, and the probable course of the law in the matter can only be inferred from the cases which have brought the matter indirectly before the courts.

In the case of *West Roxbury vs. Stoddard*, the tendency seems to have been to favor the common law rights of the public *against* those of riparian owners. Judge Hoar gave as his opinion that "fishing, fowling, boating, bathing, skating or riding upon the ice, taking water for domestic or agricultural purposes, or for use in the arts, are lawful and free to all persons, upon these ponds, if such persons own lands adjoining them or can obtain access to them without trespass, so far as they do not interfere with the reasonable use of the ponds by others, or with the public right, unless in cases where the Legislature have otherwise directed."—7 *Allen*, 171.

Shaw, C. J., in *Cummings, et al., vs. Barrett, et al.*, 10 Cushing, 188, says: "What the rights are of adjacent or riparian owners of land bordering on such ponds (great) has, we believe, never been the subject of adjudication or discussion."

The common law right will probably be recognized in the courts, but the most important point is to decide what shall constitute trespass with damages against parties passing over the lands of riparian owners to reach great ponds for the purpose of fishing therein.

If roads exist, leading to such ponds, actions against parties for trespass on riparian lands, when such roads might be used, would probably lie.

By the Colony Laws the common law right to fish in rivers, so far as the tide ebbs and flows, is sustained.

Nevertheless, in 1779, in the case of *Freary vs. Cooke*, 14 Mass., 488,* an attempt was made by riparian owners to assert their right to the fishery *ad filum aquae*, and to get damages from the defendant for fish taken therein. In this case the plaintiff urged a *custom* as defence, which was not sustained by the court, the custom not being established as valid. Moreover the tenor of the decision seems to favor the view that no custom would have availed in prejudice of common law rights.

In *Coolidge vs. Williams*, it was decided that if the Legislature makes no disposal of the fishery rights in navigable rivers, riparian towns may dispose of the same, and if such towns do not avail themselves of this privilege, then all inhabitants of such towns may take fish in such rivers, provided they do not trespass on the rights of others. Private statutes are not to be construed against existing rights and privileges.

The decision of this case extends the privilege, given by the colony laws to householders, to all citizens.

In *Commonwealth vs. Chapin*, it was urged, on the authority of Pennsylvania precedents, that the common law doctrine as to navigable rivers did not apply to great rivers, such as the Connecticut, and that such rivers were, in the technical sense, navigable above the ebb and flow of the tide, and that riparian land owners could have no common law rights in such great rivers.

But it was decided that in this State *all* rivers are navigable so far as the tide ebbs and flows; that in navigable rivers fishing rights are common.

But above the ebb and flow the public have right of way, though not a right of fishing, for the public have an easement for passing in boats, etc., in rivers, which, though not classed with navigable rivers, are in fact navigable rivers for craft above the ebb and flow of the tide.

An interesting question here comes up as to the exact definition of the

*The river being navigable at this point.

point where the tide ceases to ebb and flow. I have examined the cases very carefully with reference to this point, and have been able to find no decision which touches upon this matter and no reference to such a decision. The practical state of the case is that any plaintiff would have to prove that the tide did not ebb and flow in the waters which he should seek to protect, just as in any action for trespass the plaintiff must begin by proving his title.

As to the doctrine of easements referred to above in *Commonwealth vs. Chapin*, "an uninterrupted adverse use during twenty years" would be necessary to establish such easement.—*Gen. Stat. Ch.*, 90, 33.

As to the obligation of dam-owners in respect to fishways in their dams, it was decided in *Stoughton vs. Baker*, 4 Mass., 522, that, although the Legislature appoint committees to make fish-ways in certain dams, partly or wholly, at the expense of the owners, said owners cannot be charged with the expense of such committees; *no prescriptive rights, from charter, or otherwise, can prejudice the right of the public that fish-ways shall be kept open and all dams are held subject to this restriction.*

The government can enforce compliance with these laws as to dams, though the complete prostration of any dam will give the owner a remedy by action at law. Finally, such committee may cause the alterations to be made under their direction; but they are not personally answerable for those whom they employ; and as the exercise of their authority is personal, it cannot be delegated to any other person, or even to one of their own number.

In this case it was openly attempted to question the right of the Commonwealth to oblige dam-owners to put fish-ways into their dams. The position seemed to be a strong one, for the dam in question was held under a charter dated in 1633, and the said charter was extended by a grant made in 1634 of a several fishery from the said dam to the weir below.

Accordingly it seems that if this right of the Legislature could be shaken in any case of prescriptive claim, it could have been so shaken in this. The result of the case evidently shows the tenor of judicial decision in this point, as well as in the matter of great ponds and estuaries, to have been in favor of *all* common law rights of the public, as against those of *all* individuals.

In the case of *M'Farlin vs. Essex Co.*, 10 Cushing, 304, as to fish as *feræ naturæ*, Shaw, C. J., said that it was the established law of Massachusetts that the *right to the soil under rivers not navigable is in the riparian owners*. If the same person owns the land on both sides of any stream, the property in the soil is wholly in him, subject to certain duties to the public; and if different persons own the land on opposite sides, each is proprietor of the soil under the water to the middle or thread of the stream (*ad filum aquæ*.) In this case, also, it was incidentally decided that no right by prescription could be acquired but by *adverse* use and occupation during twenty years, and from the mode of statement adopted by the judge already mentioned, I should doubt if such prescriptive rights could ever be acquired. At all events, it was stated in a doubtful form. Also decided that, though A. should adversely occupy ten years a fishery against B., said A. cannot transfer, by deed or otherwise, to C. his ten years' prescription, thereby enabling C., by ten years' further possession, to claim absolutely under the easement statute. From this case, and from *Waters vs. Libby*, 4 Pickering, 146, I conclude that fish in rivers are always to be regarded as *feræ naturæ*, whether the rivers are navigable or not; hence no proprietor, even above the ebb and flow of the tide, could obstruct the passage of fish; all he has a right to do being to prevent persons, acting

without his leave, from fishing on his lands, or opposite to them, *ad filum aquæ*.

The two cases of *Melvin vs. Whiting*, 10 Pickering, 295, and 13 Pickering, 184, it was decided that adverse possession and occupation on the part of an heir should be counted as part of the twenty years of such possession required by statute to establish an easement.

COMMISSIONERS

Maine.—C

New Hampshire.—
T. E. Hatch,

Vermont.—

Massachusetts.—
Ter; Thos. T

Connecticut.—W. M. Hudson, Hartford; Robert G. Pike, Middletown;
— Lord, Old Saybrook.

Rhode Is

New York.—
ert B. Roos.

New Jersey.—Dr. Benj. P. Howell, Woodbury; Dr. John H. Slack,
Bloomsbury.

Pennsylvania.—James Worrall, Harrisburg.

POSTSCRIPT, MAY 9, 1871.

The dip nets mentioned in the text have already made their appearance in front of the Columbia dam, and hand nets of the kind are plied freely. The fate of the fish baskets below Columbia has not, it seems, deterred them, and mullet fishing seems still to be profitable. It is certain that the catch at Columbia of shad this season is very much increased beyond the average. Old fishermen predict that it will be nearly, if not quite, doubled. This arises entirely from an approach to obedience to the laws of the State. Let this example be followed on the other reaches of the Susquehanna, and the same good results will follow. The Susquehanna has been lower in this last April than it has been for fifty years during the same month. The catch above Columbia may be materially affected by this circumstance. Devices to frighten the shad have, I am informed, been placed in front of both the navigation and fish sluiceways—an indictable criminal offence, yet the offenders are not prosecuted. Until this apathy is cured there will be no increase in our fisheries. Yet, notwithstanding all, on Thursday, the 4th inst., at or near Newport, Perry county, on the Juniata, eighty-three shad were caught at a haul, and there is a fair prospect for a succession of such catches before the present high water subsides. Let us give the shad only half a chance, and they will yet be as plentiful as ever. J. W.

*We have to lament the death, by a railroad accident, of Mr. Alfred R. Field, one of the Massachusetts commissioners. He was among the most eminent railway engineers of Western Massachusetts, and his professional advice has been particularly valuable in the construction of the great fish-ways at Holyoke and Lawrence.

1.50 new

Commonwealth of Pennsylvania.

REPORT

OF THE

Commissioner for the Restoration

OF THE

INLAND FISHERIES,

FOR THE YEAR 1871;

INCLUDING HIS

Special Report to the Senate on the Subject
of Fish Ladders.

HARRISBURG:

B. SINGERLY, STATE PRINTER.

1872.

1872

COMMUNICATION.

EXECUTIVE CHAMBER, }
Harrisburg, January 16, 1872. }

To the Senate and House of Representatives :

GENTLEMEN :—I have the honor to transmit herewith, for the information of the Legislature, the annual report of Colonel James Worrall, Fish Commissioner of the State, upon the restoration of the inland fisheries of the Commonwealth. The subject is one of great interest and importance. The Commissioner treats it with his usual learning and ability, and I bespeak for his report and recommendations the careful consideration of your honorable bodies.

JNO. W. GEARY.

REPORT.

HARRISBURG, Jan. 15, 1872.

To his Excellency JOHN W. GEARY,
Governor of Pennsylvania :

SIR:—It is with satisfaction I have the honor to report on the subject of the restoration of the inland fisheries ; that the year past gives us every reason to hope for ultimate success.

As may be seen by my previous reports, we commenced the experiment for their restoration, by the erection of a fish-way in the Columbia dam. This work was completed in the year 1866, and brought into operation in 1867.

The very first year of its trial, it was successful beyond expectation ; for a very respectable catch of shad was made in the Susquehanna above the dam in 1867. The fish-way was aided in some degree by an abrasion of the dam, to a considerable extent, near the Lancaster county shore, by an ice flood which took place that year, and by high water during the run of these migratory fish.

Up to this period it had been generally supposed that shad came to maturity in a single season, an idea not even yet entirely dispelled. But the minds of intelligent men were brought to bear upon this subject, in all the States north of Pennsylvania, and the opinion began to prevail, after a close examination of their habits, that they did not return to their place of spawning until the second, third or even fourth year after their birth. The two year olds were so small as to be scarcely worth taking, whilst the three and four year olds were the average fish of our markets.

The largest run of shad that has been known to pass the Columbia dam was that of 1867, and the largest return of fish spawned by that run was naturally to be looked for in 1870 and 1871, according to the opinion recently formed as to the period during which they remained at sea. From the moment of the construction of the fish-way, and the passage of the law that required it to be built, the fisheries of the Susquehanna have improved. But it remained for the return of the fourth year to prove that it has had a most beneficial result.

The law of 1866 provided that no fishing should be allowed within half a mile of any of the dams through which fish-ways were erected, and in 1867 the Columbia fish-way was allowed a fair chance. So that the catch, as has been stated, above the dam, was numerous beyond expectation in that year. But local pressure was brought to bear on the Legislature of 1868, and the half mile was reduced to two hundred yards. The effect of this was to crowd the fish-way with fisheries to such an extent as to make it surprising that any fish could get through it at all. I have described a system of fishing with dip nets in my last report, which must have operated most seriously to reduce the numbers that could even approach our passage way, and since 1868, then the catch above the dam has been much smaller than that of 1867. But this is a state of things that can be remedied. The half mile can be reinstated, and the people above the dam have their fair proportion of the fishing. The great fact of 1871 is the extraordinary increase in the Susquehanna fishing, from its mouth to the dam at Columbia.

It is believed, and I think any fair mind will confess with reason, to be due to the extra natural spawning of 1867, afforded by the respectable number of fish that found their way to the fine spawning ground between Columbia and Duncan's Island.

Very soon after I was appointed Commissioner of fisheries, I discovered that unfair, unsportsmanlike, nay piratical fishing was quite as much the cause of the deterioration of this great material interest as even the erection of the navigation dams. I assisted in preparing the earliest of the laws, and these laws made fight against the fish baskets or kiddles. Year after year clauses were introduced for their suppression. In my last report I gave a history of their demolition in England, which took place as long ago as in the thirteenth century. No law, however, seemed as if it could reach them in Pennsylvania, until at last, at the last session of the Legislature, a statute was enacted making it mandatory upon the sheriffs of the riparian counties to tear them down, aided, if necessary, by a *posse comitatus*, and at last they are beginning to disappear, although they are not quite extirpated yet.

The earlier laws have had some effect to be sure. In 1870 Lancaster county showed some energy in their destruction below Columbia, and not too soon, for many of them were thus got out of the way, giving an opportunity for the product of the increased run of 1871 to reach the ocean.

Up to 1870 a Columbia shad of any size used to bring at Columbia, within a couple of miles of where it was caught, the biggest end of a dollar, and some of them brought even more than a dollar a piece. In 1871 the finest Columbia shad were hawked in the market at Harrisburg, thirty miles from the fisheries, at considerably less than a dollar the pair.

The catch at Columbia considerably exceeded 100,000; and it is entirely

fair to conclude that this has been caused by the erection of our fish-way at Columbia, and the fight that has been made against piratical fishing.

We have fortunately collateral evidence going to prove this. In the very year that the opening at Columbia was made, shad were spawned artificially in the Connecticut, at the expense of the State, by Seth Green, of New York, (the inventor of artificial shad culture,) to the extent of two millions, and in the corresponding year 1871 we find the catch in the Connecticut exceeding any take for as far back as the year 1802, thus by a single experiment making up the losses in that river which had been increasing yearly for over three score years. Green, about the same time, spawned some shad in the Hudson, and in the Hudson we found that in 1871 the catch increased to such an extent as to lower the price of the fish in New York city from fifty and sixty cents down to an average of say thirty-five cents.

But no experiment of the kind was made in the Delaware river, nor was the habit of fishing disturbed there at all, and in the Delaware no marked increase in the catch was observable in the year 1871.

There surely is enough here to predicate an opinion that if the shad be allowed any the least chance, naturally or artificially, that they will multiply so as to satisfy almost any demand that the population along the streams are likely to make upon them.

I have refrained from making any recommendation of expense to bring about this desirable result until I could feel perfectly justified in doing so. But I think the time has now come to recommend a small expenditure on the part of the State in this direction.

But it is not only shad that are beginning to reward us with some result for our endeavors to rehabilitate our streams.

There are numerous other fish belonging of right to these water courses, and one species at least, which has recently been introduced, which will be equally increased in numbers. The list of fish indiginous to the Susquehanna and the Delaware, all of which are good substantial food, has been stated as reaching over thirty. Of these, there are two which are beginning to re-appear, and were caught in appreciable numbers during the year 1871, in the neighborhood of Harrisburg. These are the wellknown yellow perch and the rock fish.

The Potomac black bass, or rather, indeed, the black bass of the western rivers, first introduced into the Potomac, and then into the Susquehanna, are decidedly increasing. The number of black bass brought here from the Potomac, within the last three years, cannot have exceeded three hundred. Yet there is scarcely a net taken up in the reach of the river, in this neighborhood, or in the fifty miles from Columbia to Duncan's Island, at this time, in which cannot be found some of the progeny of that very

small number. And, indeed, some of the adults have made their way through the Duncan's Island or Clark's Ferry navigation schute, and have been taken in the vicinity of Selinsgrove and Sunbury. Nay, one or two have been reported to have been taken in the North Branch, *above* Sunbury. I am pleased to report that the fishermen, generally, return these fish to the stream when caught alive. But those that are caught in the fish baskets are sure to die, as many of them have done unfortunately. The magnificent Susquehanna salmon, improperly so called, being in reality a pike perch, somewhat resembling, I believe, the mascalonge of the St. Lawrence, since we have commenced our fight against the fish baskets, has increased quite appreciably.

I find amongst my excerpts, an able anonymous article, culled from one of the Philadelphia papers, in which the fish of our waters are treated of. From this I give you the following list; and when we consider that there is absolutely nothing to be done but to observe the very reasonable laws, which the Legislature has passed on the subject, to increase the numbers of these, so that they can be bought and used by the poorest of our riparian inhabitants, surely every citizen ought to feel bound to have the laws enforced, and the Legislature should render all the aid that may reasonably be asked of it, to bring about so desirable a result.

I quote from the article as follows :

"There are at least one hundred and twenty species of fresh water fishes in the waters of Pennsylvania, omitting those of Lake Erie, of which seventy-six species are important as food. Thirty-one species exist in the Delaware and its tributaries, which are either now used as food or will be at some future time. About the same number are found in the Susquehanna, while there are forty-one inhabiting the Allegheny and its branches. When we reflect that each female of these species spawns several thousands or hundreds of thousands of eggs in a season, we can readily estimate the great importance this crop might be to us, as a source of cheap animal food, were it cultivated to the extent of the capacity of our streams.

"That capacity in Pennsylvania is very great, for it depends chiefly on the supply of food for fishes furnished by nature. This is ultimately derived from a strong vegetation, either directly or through the insects which feed upon it, or the fishes thus nourished as food for the carnivorous species. Ultimately, then, a productive soil is as much the condition of fish production as of any other, and thus our State possesses, evidently, extensive advantages in this respect.

"Some of these species migrate to salt water in autumn, and remain there during the winter; others descend the creeks to the rivers, and the rivers to their deeper waters, and congregate in them during cold weather; others remain all winter in their usual haunts, burying themselves in the mud,

and undergoing a kind of hibernation, while some, for example, certain catfish, do not take even this precaution. With a few exceptions, on the advent of spring, and the breaking up of the ice, they ascend to the upper and clear waters, or to the gravelly bottoms, to deposit their spawn. The exceptions are the eels and the trout. The former descend the rivers in autumn, and deposit their eggs in salt water; the latter spawn in the upper waters, in late autumn, prior to their riverward, or in the case of the salmon, seaward migration. Of course no fishing is (or ought to be) permitted by law, during the months of spawning.

“Where the fishes avoid dams and other obstructions, by fish-ways, (or navigation sluices,) these should be especially guarded, to prevent the wholesale destruction which can be inflicted upon them at such times.”

In speaking of the different species, the writer goes on, excluding from his list the *Alosæ*, or shad tribe, as being well known to most readers.

“We mention here that an Anchovy (*Engraulis Vittalus*) visits Delaware river and bay in immense numbers every spring, and might furnish quite as large a supply of food as the European species of the same name.”

Then follow the salmon family, of which the brook trout and the sea salmon are the most important. Although experiments are being tried with this latter delicious and magnificent species, the writer does not place much hope in their success south of the Hudson, and fears that it will never be an important feature of the Delaware and Susquehanna fisheries. Let the experiments, however, go on, there is nothing like trying, though southern latitudes have a tendency to dwarf and otherwise deteriorate the northern tribes of fish.

The white fish, however, of the lakes, might be cultivated in various parts of Pennsylvania, and perhaps would succeed in our large eastern rivers.

Then comes the perch genus, of which the pike perch or Susquehanna salmon is about the best. These, as has been stated, are showing a decided increase in the Susquehanna, and they were not originally found in it but were introduced into the upper waters in the State of New York. There is a smaller species, almost as good, found in the Allegheny and its tributaries, which might be introduced into the Susquehanna without any difficulty, and both might be placed in the Delaware.

Then we have the yellow and white perch and the rock or striped bass, so well known in both our great streams. These will undoubtedly increase when unfair fishing shall have been put down. Then there is the black bass and the white perch, or moon perch of the Allegheny, which can as easily be transported to our eastern waters if it is not found to increase from the occasional stragglers already caught in the Susquehanna. Even

the smaller sun fishes have considerable market value, and with the others will increase and multiply.

To these may be added the pike, the pickerel, the eel, and different kinds of catfish, which can be brought over from the Ohio. This brings the number in the list to about twenty, about three-fourths of which already exist in our streams. But there are the carp, the suckers, the chubs, the mullet, now not so much valued, but all of which will add more or less to the increase of this kind of food so much repressed by sheer neglect on the part of our people.

There is a species called the buffalo, which is to be found in the western waters, and used as food. This attains quite a large size, and is generally taken by the spear, an attractive mode of fishing to some sportsmen.

The sucker family, although not great favorites, increase wonderfully, when they are allowed free passage up and down the streams, and although man may reject them, they are much sought after by the pisciverous tribes; and as many of the predatory fish are the choice of the epicure, the protection of the less attractive kinds will help to feed and increase the numbers of these more refined species.

We have struck at the root of the evil, which has brought about the deterioration of our fisheries, and although four or five years have elapsed since the war began, we have no reason to despair of success. The progress has been slow, but it has been sure. It took thirty years to bring about the scarcity, but it will not take, by any means, so long to replenish our streams.

There have been two causes of the trouble: First, the erection of the navigation dams; second, unfair fishing. The latter has been much the more injurious of the two. When the dams were erected, the people simply concluded that the fisheries were destroyed, and thenceforth took little or no interest in the subject; leaving the streams to the depredations of whomsoever might choose to ransack them, and destroy their products.

Unfair fishing, of every kind, ran riot, and the streams became almost entirely depleted.

Now the navigation shutes always served as a sort of fish-way, and had not the fish baskets destroyed the newly spawned fry, there would still have been a crop (so to speak) every year. But the subject was utterly neglected by the more respectable of the people, and left in the hands of men, reckless of the consequence of their system of fishing, whereby the rivers were almost abandoned by their inhabitants.

The restoration movement has proved that if fair fishing be once re-established, plentiful hauls will be the result, and all varieties will be increased.

It has also proved that fish ladders can be made, through which every variety can make their way; so that without injuring the dams, for the

purpose for which they were erected, those dams can be made to cease being obstacles to the passage of fish. The restoration movement has also proved that many varieties of fish can be increased indefinitely, almost infinitely, by artificial spawning; and has proved that many varieties can be transplanted, alive, from one stream to another, so that within a reasonable zone of latitude on our continent, all the various kinds of fish can be enjoyed by the inhabitants neighboring the streams.

But our great streams fall under the jurisdiction of various States, and it is required that the fishery laws of these States shall be assimilated as far as practicable.

This we have sought to bring about, but, as yet, without success. Concurrent legislation between New Jersey and Pennsylvania failed last year in consequence of a clashing of interests on the subject of the oyster beds in the Delaware bay. Let us hope that all difficulties will be got over during this session of the Legislatures of the two States, and that all will yet be well.

Delaware and New Jersey agreed last year, but Pennsylvania feeling somewhat hurt at the course pursued in New Jersey in reference to the oyster beds mentioned, took no interest in the other legislation, and the subject was deferred.

The laws which have been enacted here as to fish baskets, &c., in the Susquehanna, will be brought to the attention of the Legislature of Maryland at its present session; and as Maryland already begins to perceive the benefit of them even on her own fisheries, not interrupted by dams, there is strong reason to hope that coincident legislation will be enacted in that State. When the Susquehanna will be cleared from its mouth to the borders of New York, and the new era of our inland fisheries will be inaugurated, thus by far the greater of the two causes of failure in our fisheries will be disposed of. The next thing to be done will be the erection of fish-ways. The fish-way that we now possess has been more successful as a passage for shad than any other erection of the kind as yet constructed in this country. On this subject I have been ordered by the Senate to make report specially, in writing, in my present annual report. I make the report through your Excellency, as the order requires that it shall be in my annual report, but as it is a special order of the Senate, I shall address it to that honorable body, requesting your Excellency to present it, in connection with this my regular annual report.

I do not hear much complaint from the Delaware on the subject of fish baskets this year. The good sense of the owners themselves is beginning to regard them with disapprobation, and although our laws against them might have been "got round" perhaps by people so disposed on account of

the joint riparianism of New Jersey and Pennsylvania. There are but few of them left.

The black bass set free in the Delaware, near Easton, last year, to the number of five or seven hundred, I am informed by one of the New Jersey commissioners, "have been heard from, from Fort Delaware to Port Jarvis." This is surely very satisfactory, as the distance embraces hundreds of miles. There are no dams in the Delaware from the New York line to its mouth, and, therefore, the failure of the fisheries on that river has been caused exclusively by unfair fishing and over-fishing. There is really but little to do to completely re-instate the fisheries of that grand stream. Concurrent laws would have a beneficial effect on both sides of the river; there is no fishing interest that would be injured by them. A statute of three or four clauses would cover the whole ground—the evils to be remedied can be specified in a very few words, as thus:

1st. Regulate gill-net fishing, prescribing the size of the meshes, requiring uniformity, &c.

2d. Provide for some few hours of "close time," i. e. prescribe a period in each week in which there shall be no fishing, so that the fish may have some chance to reach their spawning grounds; or even let the sacred Sabbath hours, commencing at sunset on Saturday and ending at sunrise on Monday, be made a close time. Such a provision as this ought to be enforced in respect to the usages of christianity alone, without reference to the material interest.

3d. Prescribe a period in the summer to be agreed upon when all fishing for shad shall stop.

4th. Let all systems of fishing, which destroy the smaller fry incidentally, and for the sake of taking the adult varieties, be stopped.

The above four clauses, properly arranged into a statute, would cover the whole ground, with an additional clause providing for the due enforcement of the law.

I understand that the commissioners of New Jersey, encouraged by the success of our northern neighbors, will recommend an expenditure of a few thousand dollars in artificially spawning shad this year, notwithstanding that our concurrent legislation is yet imperfect. I would recommend Pennsylvania to do at least as much as New Jersey shall be willing to do in that line. Seth Green says that he can bring so many millions of young shad to life, that if the river be clear of dams, "you can't fish it down if you were to try," by which I understand him to mean that he would dare the worst that gill netting and fish baskets could do. But a slight allowance should be made for his enthusiasm, notwithstanding his splendid successes; and the indiscriminate and ill-regulated systems of fishing should be provided against before going to the expense of artificial spawning.

If the regulations recommended be carried into effect, *success is certain*, and the Delaware like the Connecticut can be made to show a catch greater than any since 1802, or to a period in the past "wherein the memory of man goeth not to the contrary."

New York has shown great enterprise in the restoration and propagation movements; but she is somewhat differently situated from Pennsylvania. She has some six or seven hundred beautiful inland lakes, and her attention has been turned to stocking these.

The State has established a hatching house, whence great numbers of her prime fishes have been distributed in the form of ova and of fry.

These have been distributed amongst her lakes and streams, and we shall come in for our share in time, of those which are placed in the upper waters of the Susquehanna. Amongst the list distributed, I find that "four hundred bass" have been placed in water that passes through our State, and reaches the Chesapeake. There is no danger but what these will eventually work down stream, and be caught at our very doors. Besides this little supply, Mr. Green made us a present the other day, of some six hundred salmon trout ova. These, as we have no hatching house belonging to the State, I have had placed in private hands at a hatching establishment in the neighborhood of Harrisburg, under the charge of Messrs. Seiler and M'Conkey, with the understanding that when they reach a size that will warrant their being trusted to their own resources, they shall be placed in the Susquehanna. This must be regarded as a complimentary present from New York to Pennsylvania. Perhaps as we get on, and have a hatching house of our own, we may be able to return the compliment.

I find that a plant of black bass, taken from the Potomac at Cumberland, and placed in the Raystown Branch of the Juniata, some years ago, has turned out to be a complete success. These bass, many of them, have reached to several pounds in weight, and can be caught in abundance in the sequestered loops and bends of that beautiful stream below Bedford. On the main Juniata, some were placed within a year or two. I am afraid that the war against fish baskets has not been prosecuted there with quite the vigor which has been exhibited by our Susquehanna sheriffs. Let me assure the people of that section that if they want bass or any other fish in their stream, their cry must be, "down with the kiddles;" there can be no success where those vile contrivances are allowed.

Now what we want on the Susquehanna, is pretty much what we want on the Delaware. We must have a close time on the lower waters. We must open more of our dams. We must thoroughly repress all unfair fishing, and then let us propagate. We know that we can make fish ladders, for we have made one that has met with fair success; all the rest is easy. We have Maryland to deal with on the Susquehanna, as we have

New Jersey on the Delaware. I am given to understand that the best of feeling exists in Maryland, and I am already in correspondence with a prominent fisherman on the lower Susquehanna, who says he doubts not that all reasonable concurrent legislation can be attained.

I close my report to your Excellency, by an imperfect list of the fishes which we might have in abundance in our great streams. Yet imperfect as it is, what a boon it would be to our people were these fish, or even half of them, to be had in our markets, at reasonable prices.

A LIST

Of some of the tribes of fishes, a portion of which are, and all of which might become inhabitants of the Delaware and Susquehanna rivers and their tributaries, in the riparian States of Maryland, Delaware, Pennsylvania, New Jersey and New York. (Some of the more familiar generic names are given in italics.)

The shad, alewife* and herring. (*Alosæ.*)

The Delaware anchovy. (*Engraulis Vittalus.*)†

The sea salmon* and brook trout. (*Salmonidæ.*)

The white fish.* (*Coregonus.*)

The pike perch, 2 species. (*Percidæ.*)

The yellow perch. (*Percidæ.*)

The rock and white bass.

The black bass.

The white or moon perch of the Allegheny.

The sunfish, 3 species (at least.)

The pike, 3 species (at least.) (*Esox-socidæ.*)

The pickerel.

The eel, 2 or 3 species.

The catfish, at least 3 species.

The carp, sucker, mullet, chub, buffalo, &c., pluralities of each.

There are over thirty, some of which are, as stated, now to be found in the streams mentioned, but all of which might be made plentiful in them, and it is so easy. For instance, most of the fish of the Allegheny and the Monongahela, can be got at Pittsburg alive.

For a five dollar bill you could buy a tin vessel, and fill it with any one of the species attainable there, by giving word to the fisherman, at the market, a day or so before hand; and probably without changing the water more than once, say at Altoona, empty your vessel and its fish into the Susquehanna, in eight hours after the purchase was made. Black bass

* Uncertain but should be tried.

† A sea fish, but which might be transplanted to the Chesapeake bay.

were introduced to, (and now fill the Potomac) precisely in that way, and they were brought from the Potomac to the Susquehanna, bidding fair to fill it in the same manner.

Almost any species can be brought across the mountains, and *settled* in our streams, for about \$100 for each kind. If we remain much longer without disseminating these excellent species, when it can be done so cheaply, it will be our own fault.

Then, again, there are some kinds that can be sent in the form of ova, by mail, even in a letter, the postage of which would probably not reach fifty cents.

The 600 salmon trout I got in the form of ova, from York State, the other day, tin vessel, transportation and all, did not amount to \$2 00. Of course, the eggs had a market value, but that was made a present from New York to Pennsylvania. But supposing they came from a private hatching house, the whole plant could hardly have cost more than \$20 or \$30, at the highest.

Now there are catfish in the Ohio that reach over a hundred weight. Why might not we have a few of those old flappers to give variety to our Susquehanna waters? It is as easy to transplant fish as it is to transplant potatoes. But you must pay some attention to your fish after transplanting; you must watch them and care for them, and not allow them to be destroyed by pirates, as you must prevent your potatoes from being rooted up by hogs. Let us start this thing; let every respectable town on our waters have at least one "kettle of fish" brought across the mountains and flung into the Juniata, the Susquehanna, or some of their tributaries; then down with the kiddles, open the dams, and our whole population will share, and share alike, in this cheap, excellent and various food.

I must now proceed to my report on fish-ways to the Senate.

I am sir,

Very respectfully,

Your obedient servant,

JAMES WORRALL.

REPORT.

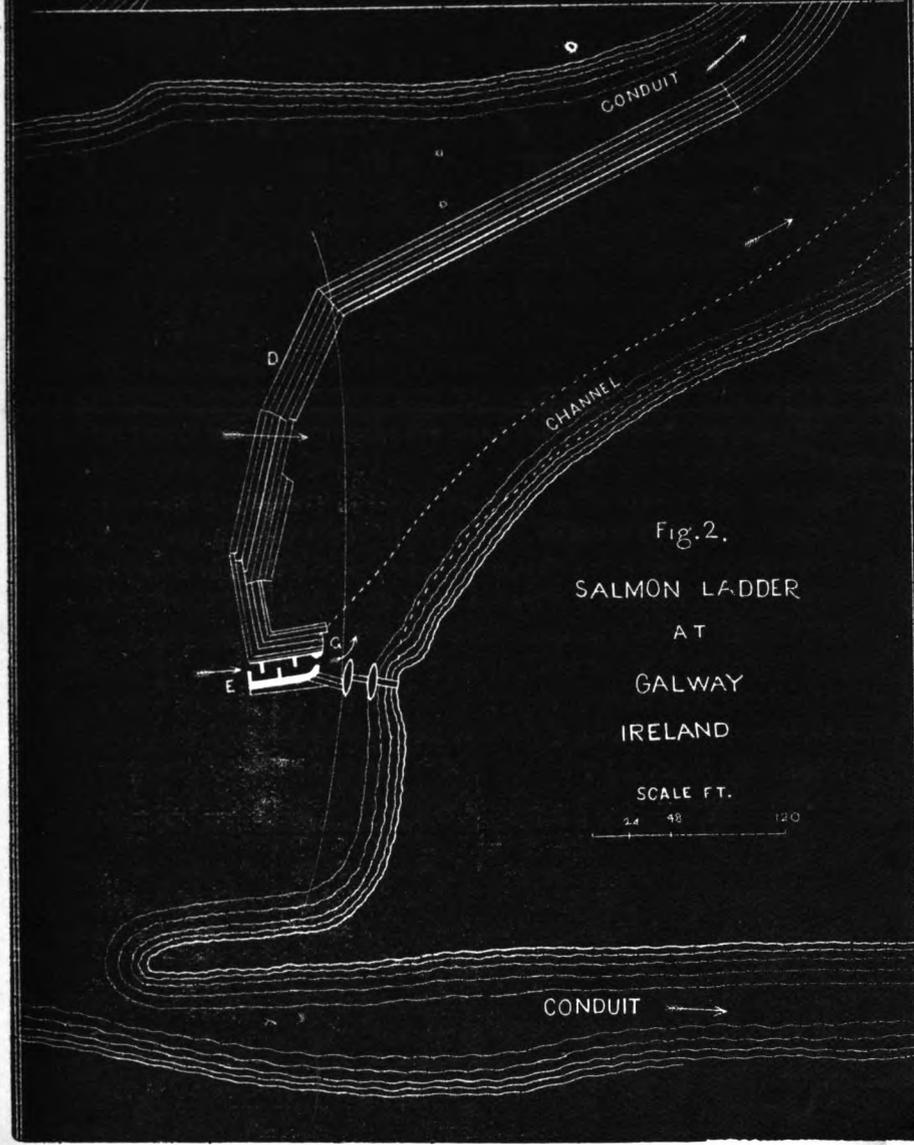
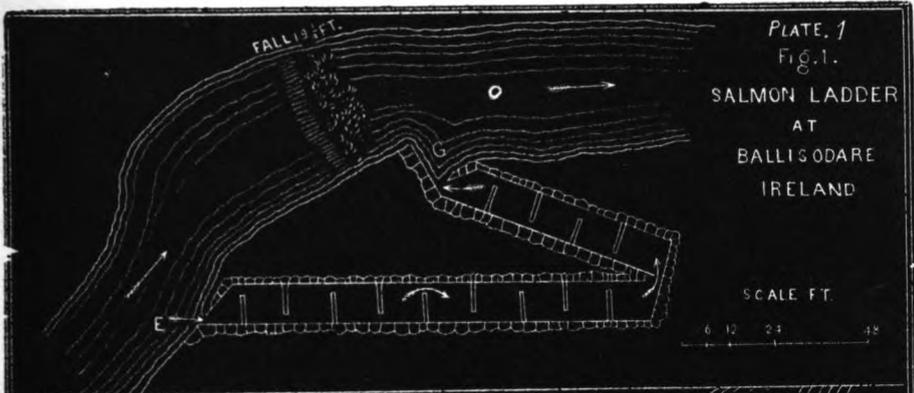
*To the Honorable the Senate of Pennsylvania, in session at Harrisburg,
A. D. 1872:*

GENTLEMEN:—About the first of last June I received a note from the Chief Clerk, Mr. Ziegler, stating that the following resolution had unanimously passed the Senate:

Resolved, That the Fish Commissioner of the Commonwealth, in his annual report, is hereby requested to make or cause to be made an estimate of the probable cost of constructing and putting into the several dams in the Juniata, Lehigh and Susquehanna rivers, and their branches, suitable and proper fish-ways to admit of the passage of fish, and report the same in writing to the Senate at the next session of the Legislature.—*Extract from the Journal.*

As the whole subject of fish-ways is comparatively new in this country, I determined, in endeavoring to fulfil the request of your honorable body, to make diligent inquiry and ascertain as nearly as practicable the best form which had been attained for fish-ways in the United States, and make an estimate of the cost of such form, and in order to give satisfaction as to the probable correctness of my estimate, and to show how I came to my conclusions as to the best form, I have deemed it proper to give a short history of the adoption of the fish-ways, with some account of their success, both where they originated and where they have been established in our own country. In doing this it will, I think, not be out of place to accompany my report with some diagrams taken from the best authorities I can find, comparing the plan adopted in Pennsylvania, which, differing in some respects from the others, has not been without its fair measure of success.

Although fish culture, *i. e.*, artificial propagation, is an old art. Indeed, it was practised by the ancients and lost, but has been recovered in modern times, and brought to its present success, since the coming in of the present century. Yet fish ladders or passes don't seem to have a history extending back over thirty or forty years. The most perfect in Europe, are two, which were constructed in Ireland, and for the purpose of conveying an idea what a fish-way is, I give the plans of those two, for which I am indebted to the report of the Maine Commissioners, who copied them from the Irish authority.



Although these fish-ways or ladders, as Mr. Roberts, the Irish Engineer, calls them, are intended for salmon, a much bolder, more powerful and persistent fish than the shad, the principles of construction apply, to a certain extent, to a fish-way for shad. In the description of our American fish-ways, the modifications will be perceived, and these Irish plans will be interesting, and will tend to impress the idea of a fish-way on the mind of a person seeking to understand the subject.

Mr. Roberts* gives the following description :

Drawing No. 1, (pl. 1, fig. 1, of this report,) is a plan of the ladder on the Ballysodare fish-way, in the county of Sligo. The obstruction here consists of a natural rock ; the ascent is $19\frac{1}{4}$ feet, and almost vertical, over which no salmon had ever previously passed. The length of the salmon ladder from inlet to outlet, is 174 feet.

It is divided into 15 pools, each of which is 10 feet wide and 11 feet long, and the average depth of water ponded in them is 15 inches. The inlet to this ladder is only 10 inches wide, with a depth of $2\frac{1}{2}$ feet of water flowing through it, at the ordinary level of the river.

Mr. Roberts's second drawing, being so like drawing No. 1, I do not reproduce it.

Drawing No. 3, (plate 1, fig. 2, of this report,) is a plan of the ladder in the weir at Galway, on the river Corrib. This weir was formed for the purpose of maintaining the level of the water for navigation and mill power. The ascent, at the ordinary level of the river, is 5 feet. The length of the ladder is 46 feet, which is divided into 5 pools, each being nearly 10 feet square, and the average depth of water in them is 14 inches. The inlet is 2 feet wide, with a depth of 2 feet of water flowing through it, at the ordinary summer level.

These ladders are admitted to be most perfect and successful.

There is no other means for the fish to pass up, and the upper reaches have by the means of these ways exclusively, been thoroughly stocked with salmon.

These Irish ladders, and similar structures in Scotland, gave rise to the Foster fish-way, which was first constructed in Maine by the lamented Mr. N. W. Foster, now no more, he having been in the latter years of his life a commissioner for that State. In my report for 1868 I gave a sketch of the Foster fish-way, taken from the Massachusetts report.

It was soon found necessary to modify this fish-way, as it had a tendency to create eddies, indeed small whirlpools, in which the fish obeying their instinct to swim against the current, used to circumgyrate, so to speak, until they would become giddy and would float back to the lower reach exhausted. The Massachusetts and other New England commissioners soon remedied

*Samuel U. Roberts, Esq., M. I. C. E.

this, as it was very easy to do, by constructing the bulkheads in such manner as to lessen the tendency to form whirlpools; and they have now produced a fish-way which has been already successful for the passage of all their anadromous fishes, except shad, but the present plan which I shall now give in this report, they fully expect will be equally practicable for the latter variety.

In producing a plan of the Massachusetts fish-way, I give the original remarks of Col. Theodore Lyman, a very high authority, which accompanied the copy furnished to me by the Massachusetts Commissioners.

“The first condition of a good fish-way is this: *that the water should flow for its whole length with a uniform swiftness.* When this condition is answered, the fish being opposed by a constant pressure, has no disposition either to stop or to turn back, but pushes directly through. If it were possible to use a simple trough leading from the crest of the fall straight to the water below, we should have the best sort of fish-ways. But since water flowing in a simple inclined trough, moves with an increasing velocity, it is necessary to introduce bulkheads which practically close the trough and check the flow, which thus takes on a serpentine form and moves with a regular speed and direction, except at the angles of the bulkheads where there are small eddies.”

He then goes on to explain the plate, (plate 2 of this report,) fig. 1—an Improved “Foster” Fish-way. “This pass, contrived by the late Nathan W. Foster, Fishery Commissioner of Maine, and perfected in its details by my colleague, E. A. Brackett, is usually built of plank and timber, but it can be made as well with masonry. This figure shows it in elevation with the head set *into* the face of the dam and the foot resting in the river below. It will be observed that the floor is a uniformly inclined plane without depressions to form pools or resting places. The floor of a fish-way should be as *smooth* as possible; a still pool or a large eddy is a temptation to the fish to loiter or to turn back, and the old idea of making such pools is an error. Fig. 2 shows the same in plan with the cross bulkheads A A, and the girders which brace the plank sides. The upper entrance is at B and the lower one at C. Fig. 3 shows a “return” fish-way, that is one which doubles on itself and comes back toward its starting line. Fig. 4 shows the manner of arranging the bulkheads at the “return,” so as to have a uniform flow. Figs. 5 and 6 are drawings somewhat enlarged, showing details of construction. Fig. 7 shows the “slide” or gate by which the volume of water is regulated at the head of the fish-way. (B.) (See also B. fig. 1.) Fig. 8 shows a section of the slide or gate, (S) which should never play up and down, but always sideways. The fish-way when not over 100 feet long may fall 1:10; when longer than that, it may fall 1:12 to 1:15. The width of the openings through the bulkheads should be about

one-third the width of the fish-way. The width of the latter is usually $2\frac{1}{2}$ to three feet, and the width of the opening is therefore 10 to 12 inches."

Fish-ways of this form have had complete success with salmon, (*Salmo salar*,) trout (*S. fontinalis*) and alewives, (*Alosa tyrannus*,) but have not yet been properly tested with shad. (*Alosa praestabilis*.) All the common fresh water fishes, (*Perca Leuciscus*,) *Custostomus Anguilla*, &c., pass up with the greatest ease."

Thus I have the honor to lay before you, the American fish-way, with its latest improvements, as devised and adopted in the New England States.

Let us now return to Pennsylvania, and see what we have done here. It will be remembered that our fish-way was completed about at the same time that they were completing theirs, and, indeed, it was not without consulting them that we proceeded with ours.

Reflecting on the same subject, we had come to similar conclusions with them, namely, that a simple inclined trough would be about the best form to adopt, provided that the accelerated speed of the water could be reduced to a uniform velocity. They, at that time, supposed that shad could overcome an inclination of 1:10, but for perfect safety, I adopted 1:15, disregarding the steeper suggestion, which was not only made by them, but by the practical men in Pennsylvania, whom I consulted, and who also proposed 1:10.

It will be perceived that the gentler slope has since become the better opinion, and an inclination of "from 1:10 to 1:15," is recommended according to the length of the structure. For shad, I should adhere to the minimum slope, as it is certain that they are about the least persistent of the tribes which ascend our ladders.

Our fish-way, then, is precisely what has been recommended as the best, except that uniform velocity is effected by the water below the dam backing up into the aperture, which in dams as low as six feet in height it must almost always do, for the stream must be at least three or four feet in depth in front of and below the dam during the run of the shad, when the stream is commonly in a state of freshet. I have described this effect in one of my former reports.

We differ from them, besides, in another important respect.

Our trough is cut into the dam instead of being constructed in front of it. Thus it is almost impossible for the fish to miss it, as when they meet the obstacle of the dam, they move along it until they find the opposing current, against which their instinct prompts them to ascend.

When we come to consider dimensions, however, the American fish ladder appears to us to be almost ridiculously small; its width being measured in inches, and our streams being on their main stems often more than a mile in width.

How narrow an aperture a shad will ascend is not as yet known. One of the Massachusetts commissioners tells me that a few individual shad have been known to ascend the ladder at Suffolk dam, (I think it is,) in the neighborhood of Boston, the ladder of which is of the small dimensions, inferred from Col. Lyman's description; but on the Susquehanna the narrowest width of our fish-way is 20 feet.

The plans submitted in this report, although indicating small dimensions, are correct in principle, and can be enlarged to suit any stream when that principle is once understood.

I will try to give in words what a true fish-way is, and with this definition and a consultation of the plans submitted, no intelligent millwright or dam-builder can be at a loss to go about its construction.

A fish-way, then, for shad, is an inclined trough, either constructed in front of or cut into a dam or other permanent obstacle, (say a ledge of rocks, as in one of the Irish cases,) the inclination being 1:15, the bottom to be smooth. The accelerated force of the water, say two feet at least in depth, flowing through this trough, must be retarded and made uniform, either naturally or artificially. It can be so retarded naturally in dams of six feet high, or less, by the water below the dam backing into it, provided that water be three or more feet in depth during the run of the shad. But if this state of things does not exist, then it must be retarded artificially by the construction of bulkheads protruding alternately from the sides of the trough, in such manner as to give a serpentine direction to the current—a direction (as Mr. Brackett, who is an artist, and to whom is due these later improvements, described it to me,) something like the "line of beauty" of Hogarth, the great English painter. This line of beauty is gently undulating, but not mathematical. It will be a near enough description to say that if the line were composed of the curves of equal circular segments, reversing, alternately, the middle ordinate or versed sine, as it is sometimes called, of those segments, would be about $\frac{3}{16}$ the length of the chord. I have taken the pains to get this dimension from a small edition of Hogarth, belonging to a friend of mine.

The opening through which the water flows through this trough, should not be more or less than one-third of the width of the trough, and the bulkheads, constructed in the trough, should not be made at such angles as to create circular eddies in the corners, for these, as I have before mentioned, have a tendency to mislead the fish, and tire them to exhaustion.

The water, as it flows, should not be allowed to reach such a velocity as to create bubbles of air. It should be "black water," as Mr. Brackett, the Commissioner, expressly said.

I am decidedly in favor of cutting into the dam in preference to building in front of it, though the latter method is certainly the cheaper of the two;

indeed, it would scarcely cost more than half or two-thirds what the incision plan would.

As to method of construction, let the above conditions be satisfied, and whatever construction will best stand the vicissitudes, the result of the regimen or habit of the stream, will answer. Let the opening be made in the channel up which the fish were known to have passed before the construction of the dam, and they are not likely to miss it. And if they were never known to have passed up, then let the opening be made in the main channel of the stream.

In a stream like the main Susquehanna, where the dam is low, like the Columbia dam, a clear trough of twenty feet wide will undoubtedly answer. A single opening in such a dam as that, the dam being a mile and a quarter long, is not enough. There should be another. Where dams are higher, the whole width should be thirty feet, and the serpentine current made ten feet wide.

On the West and North Branches, say as far up as Williamsport and Wilkesbarre, twenty-one and seven should be the dimensions; the same on the Juniata as far up as Lewistown, and so on the Lehigh up say to Allentown. But higher up these streams, and on the smaller branches of the Susquehanna, the dimension might be reduced to 15 and 5, and to 9 and 3. Through a lower dimension it is, I think, rather problematical whether shad would ascend. They are expected, however, in New England, even through smaller ladders. I should prefer to await the result rather than build, anticipating the advent of shad. All the other tribes, however, as Col. Lyman observes, have taken their ladders with ease.

We now have certain dimensions from the largest to the smallest that are likely to admit shad, and the best way to come at a statement of their probable cost is per foot rise of dam. The clear 20 feet trough, cut into the dam, may be estimated at \$1,000 per foot rise; the 30 and 10, that is a trough 30 feet wide, calculated for a current of 10 feet, might cost something more, but may be put at the same, as the dam would be higher, and the ratio of height to width might bring the price per foot to an equality. The 21 and 7 would be, say \$900 per foot rise; 15 and 5 would be \$750, and 9 and 3, say \$500. These prices are for incision ladders, formed so as to be of no injury to the dam, and constructed substantially so as not to be injured by freshets.

The cost of ladders in front of the dams would be from 30 to 40 per cent. less, and can easily be so estimated.

These estimates are based upon the average condition of a dam and its surroundings, and may, therefore, be materially modified by favorable circumstances. It is often found, for instance, that a fish-way may be created around a dam or other impediment, in which case the cost might be very

materially reduced. There is one in the New England States that did not cost more than \$150 per foot rise. The prices I give are *high* enough; they are more likely to be changed by reduction than by addition.

Calculating by these prices, then, the cost of accommodating "the Juniata, Lehigh and Susquehanna rivers, and their branches," with fish-ways, (confining ourselves to those branches embraced in the fish laws,) would be about as follows—and for the branches not so embraced it will be easy to deduce estimates from the prices heretofore stated—for any dam. These fish-ways, it must be remembered, are such as can be presumed to answer for shad; those for smaller fry would be proportionally lower, even as low as \$150, as has been stated, per foot rise; and as the principles and modes of construction are the same as shown in these plans, the cost for any locality in the State can be easily come at, whilst it would be somewhat difficult to estimate what a full suit of fish-ways for all the main stems and branches of "the Juniata, Lehigh and Susquehanna" would reach:

The main stem of the Susquehanna, say from Columbia to Northumberland—including an additional ladder at Columbia—would cost	\$20,000
The Swatara from its mouth to Jonestown	15,000
The Juniata from its mouth to Hollidaysburg	90,000
The Raystown Branch from its mouth to Bedford	15,000
The North Branch—Susquehanna—from Northumberland to Wilkesbarre*	6,000
The West Branch—Susquehanna—Bald Eagle Branch—from Northumberland to Lock Haven and Bellefonte	16,000
	<hr/>
The whole amounting to	<u>162,000</u>

At least 30 per cent. may be deducted from the above if the ladders are built in front of the dams, and it is believed that many circumstances may occur to reduce the estimate, whilst it is, as has been stated, not likely to be increased.

I have hesitated, heretofore, to recommend the State to go to any expense in this matter of the restoration of the fisheries, until I could feel certain that expense would be reimbursed by success. I have waited first to find the root of the evil, and then the remedy.

I have stated before, that in addition to the navigation dams, the cause of all the trouble has been unfair fishing. What little has been done, through great exertion, has been made to reduce this evil, and is already bearing its fruits. We see tribes returning to our rivers, which had al-

*As the dams above Wilkesbarre are expected soon to fall into disuse, there is no estimate made for them.

most disappeared, and new tribes are flourishing, and are likely to flourish. It is certain that openings or ladders can be made in or upon the dams, which shall be accessible to the fish. And it is certain that fish can be propagated artificially in almost infinite numbers. So that it seems not at all unreasonable to hope that our streams can be brought to their former fruitfulness. We have evidence of this in our own State, and in our neighboring States. A small expenditure of money, as has been seen, will re-habilitate the Susquehanna from Columbia to Wilkesbarre, and say Milton or Williamsport. I would recommend *that* expenditure to be made.

The Delaware river, fortunately, is not crossed by a single impeding dam, until after the State line of New York is passed. Unfair fishing is gradually disappearing from that great stream, and it is hoped will soon disappear altogether.

New Jersey is to be asked for an appropriation, for the artificial propagation of shad in the Delaware. If our sister State makes such an appropriation, I would recommend Pennsylvania at least to equal that appropriation. New York has established a State hatching house, where all the useful fishes are artificially hatched, and thence distributed to the people of all parts of the State. Would it be out of the way for Pennsylvania to imitate this liberality? It is stated that an anchovy visits our Delaware bay in vast numbers every year. Here is a business, a production, a special commodity, that for the want of proper inquiry, we seem to be entirely ignorant of. The Delaware anchovy may not equal the Mediterranean species in value, but it can scarcely be valueless. The quantity of anchovies imported into this country is immense. Now, if we have them in our very estuaries, why need we import them? Let us learn to catch these fish in quantities, and pack them for our own use, and for sale to our neighbors, and to foreign nations.

The agitation of this subject has set men to thinking, and it is being discovered all over the country, how we have let this important interest dwindle nearly to nothing, whilst almost by a turn of the hand, it need not have suffered at all.

We have large numbers of our citizens engaged in the oyster trade, on the Delaware bay. The jealousy of a few of their own kind of men, engaged in the same pursuit, in a neighboring State, has taking advantage of some nominal territorial riparian rights, jeopardated the interests of these our fellow citizens. Here is a subject also for consideration.

But the whole matter should be placed in the hands of a competent commission, the commission of Pennsylvania having expired by limitation with the year 1871. It has been suggested that if it be re-established, it should consist of three in number, instead of one, as heretofore. I leave the matter without suggestion on my part, premising, however, that the other

States are represented in every case, by more than one member, in most cases by three; that the position has not been disdained by some of the first men in the land, and that in scarcely any case has the compensation been more than nominal, the Commissioners performing the duties efficiently and *con amore*. It is not advisable to make it a bait for the office-seeking portion of our fellow citizens. Such a commission would, no doubt, eventually succeed in re-establishing this very important branch of our material industries.

I have the honor to be, gentlemen,

Very respectfully,

Your obedient servant,

JAMES WORRALL.

POSTSCRIPT.

Private individuals have, during the past season, introduced black bass into the Schuylkill, the Brandywine and the Swatara, and an attempt has been made also on the Lehigh. I learn from the Representatives and Senators of those districts, that there is fair promise of success in each case, except that of the Lehigh, where some untoward accident prevented the arrival of the fish, or at least prevented their being set loose in the stream. I hear, as yet, of no failure where the fish have been placed alive in the new waters.

J. W.

Gaylord Bros.
Makers
Syracuse, N. Y.
PAT. JAN. 21, 1908

DATE DUE

MAY 25 1970

GAYLORD

PRINTED IN U.S.A.

