American Fish Culturists' Association.

Organized December 20, 1870.

PROCEEDINGS

OF THE

AMERICAN FISH CULTURISTS' ASSOCIATION

REPORT OF THE MEETING OF ORGANIZATION.

NEW YORK CITY, December 20, 1870.

A meeting of practical fish culturists was held in this city to-day, in compliance with a call issued November 1st by W. Clift, A. S. Collins, J. H. Slack, F. Mather and L. Stone.

The original place of meeting was subsequently changed to the rooms of the New York Poultry Society, to which society the delegates are much indebted, both for the use of the rooms and for various other courtesies extended to them during the day.

The delegates having assembled, a temporary organization was formed, with Rev. W. Clift as chairman and Mr. L. Stone as secretary. It was then unanimously resolved to form a permanent organization of fish culturists, and Dr. Edmonds and Mr. Stone were appointed a committee to draft a constitution for such an organization, to report when ready. On the presentation of their report, the following constitution was adopted, viz.:

CONSTITUTION.

Art. I. Name and Objects—The name of this society shall be "The American Fish Culturists' Association." Its objects shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success; the interchange of friendly feeling and intercourse among the members of the association; the uniting and encouraging of the individual interests of fish culturists.

Art. II. Members—All fish culturists shall, upon a two-thirds vote of the society and a payment of three dollars, be considered members of the association, after signing the constitution. The commissioners
of the various States shall be honorary members of the association, ex officio.

Art. III. Officers—The officers of the association shall be a president, a secretary and a treasurer, and shall be elected annually by a majority vote. Vacancies occurring during the year may be filled by the president.

Art. IV. Meetings—The regular meetings of the association shall be held once a year, the time and place being decided upon at the previous meeting.

Art. V. Changing the Constitution—The constitution of the society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting.

The constitution having been adopted, the following officers were chosen for the ensuing year: W. Clift, Mystic Bridge, Ct., president; L. Stone, Charlestown, N. H., secretary; B. F. Bowles, Springfield, Mass., treasurer.

It was then resolved that an effort be made to secure an exhibition of live fish at the next meeting, and that the following gentlemen be requested to prepare papers, to be read at the next meeting, on the subjects annexed to their names:

A. S. Collins—On "Spawning Races and the Impregnation of Eggs."


W. Clift—On "The Culture of Shad."

Dr. Edmonds—On "The Introduction of Salmon into American Rivers."

B. F. Bowles—On "Land-locked Salmon."

Dr. Huntington—On "Fish in the North Woods of New York."

L. Stone—On "The Culture of Trout."

It was decided to hold the next meeting and exhibition in connection with the New York Poultry Show next year. It was voted to send a report of the meeting for publication to the New York Citizen and Round Table, the New York Tribune, the Springfield Republican, the New York Poultry Bulletin and other papers at discretion; and the secretary was instructed to mail the published reports of the meeting to fish culturists generally.

Circulation of Last Year's Report.

In order that this movement of the fish culturists, the first in the way of organization in this country, might be generally known, a copy of the report of the meeting, which was just read, was sent to
all the leading newspapers in New England and New York, and to some farther west and south, and also to nearly 200 practical fish culturists in various parts of the country.

I am happy to say that the newspapers, in almost every instance, printed the report in full, or noticed it in some way.

The Agassiz Circulars.

For some time previous to the meeting of organization I had held a correspondence with Prof. Agassiz, on topics relating to fish culture, in the course of which the professor mentioned a labor, in which he is now engaged, of preparing an illustrated work of all the salmonidae of this continent, showing the variations of age, sex, locality and the like; and after the formation of the association, he suggested that the association should use its influence in furnishing material for this work.

It appeared to me so desirable a thing to have a work which would enable us to tell at a glance, at all seasons, the sex, age or locality of any specimen of the salmonidae, and also so appropriate a matter for the association to take up, that, exceeding the ordinary powers of my office, I took the responsibility of having circulars printed in accordance with Mr. Agassiz's suggestion, and very widely distributed throughout the country.

A copy was sent to all the fish culturists and fishermen, whose names were accessible, and was published in most of the leading papers in this section.

In a subsequent interview with Professor Agassiz, at his museum at Cambridge, I learned that he had been materially benefited by the aid that this effort had called out, although he remarked that not nearly so many fish had been sent in as he needed.

I consequently take the liberty here to remind you that this is a most valuable work which Prof. Agassiz is undertaking, and one which will be unsurpassed by anything of its kind in the world, and I warmly commend it to the attention and interest of the members of this association.

Mr. Agassiz cannot finish his work unless the requisite material is furnished him, and the members of this association, and all interested, cannot do the distinguished naturalist a greater kindness, nor the cause of fish culture a better service, than by sending him, as opportunity permits, specimens of the various individuals of the salmon family.

The entire expense of printing and circulating the Agassiz circu-
lars was but §8. Mr. Agassiz requested me to send him the bill for payment, but it seemed to me so becoming a service for the association to bear the expense, and so creditable to its record to be identified at this stage in its history with so good a work, that I withheld the bill from the professor, and beg permission to recommend to the association to pay it from their own funds.

St. Lawrence Correspondence.

During the session of the "High Joint Commission" at Washington, last spring, I received a letter from Hon. Stephen H. Ainsworth, asking me, as secretary of the association, to request our State congressional delegation to use their influence with the Commission to adopt some measures towards removing the obstructions in the river St. Lawrence which prevent the salmon from ascending its tributaries. I accordingly wrote to our New Hampshire senators and representatives, and the following is the correspondence which was elicited:

Charlestown, N. H., February 27, 1871.

Hon. Samuel M. Bell:

Dear Sir,—I beg leave to call your attention to a matter of very considerable magnitude, and one which the circumstance of the convening of the High Joint Commission, now in session at Washington, renders of urgent importance at the present time. I refer to the opening of the tributaries of the St. Lawrence river to the entrance and yearly migration of salmon, which are now prevented from reaching these streams by the obstructions and implements for their capture in the main river.

These tributaries form the natural routes of these valuable fish, and also contain their natural spawning grounds; and covering, as they do, thousands of miles of river channel, their fisheries would furnish annually, if the salmon were allowed to traverse these streams, returns compared with which the number now caught in the main river are very insignificant. Furthermore, the salmon of these upper streams, in many instances running through a populous country, would, from their local demand and proximity to a market, represent a money value many fold greater than the same fish caught in the uninhabited regions near the mouth of the river.

This is a matter largely affecting the interests of the communities inhabiting the basins of the tributaries in question, and it calls for especial attention at this juncture, from the fact that an opportunity is afforded by the meeting of the commission referred to for reaching a satisfactory adjustment of the difficulties—an opportunity which may not return for a long term of years.

It should be remembered that, in pressing this matter, we are not asking favors from Canada, as the Canadians on either side of the St.
Lawrence will be as much benefited by the change proposed as the Americans on this side of the river.

I am informed that the Hon. Hamilton Fish is in possession of the facts required by the commission to take the necessary steps in this matter.

I beg leave, as a representative of the American Fish Cultivists' Association, to request you to use your influence with the commission to accomplish this important end of restoring the salmon to the tributaries of the St. Lawrence; which, both from its intrinsic magnitude and the importance of its results, seems to be deserving of their attention.

I have the honor to be,

Your obedient servant,

LIVINGSTON STONE

See'y Am. Fish Cult. Ass'n.

CLAREMONT, N. H., May 13th, 1871.

Mr. Livingston Stone:

DEAR SIR,—Inclosed find a communication from the Secretary of State Department. Your communication, directed to the N. H. delegation at Washington, was duly received and laid before the Hon. Hamilton Fish, with a request on our part that the matter receive attention. After my return from Washington, Mr. Hibbard received the inclosed.

Yours truly,

H. W. PARKER

THE HONORABLE E. A. HUBBARD,

House of Representatives:

Sir,—In answer to your note, referring to a communication from Mr. Stone on the subject of the salmon fisheries in the tributaries of the St. Lawrence, I have the honor to say that Mr. Stone's letter was one of many very interesting communications on the same subject.

As the obstacles to the free access of the salmon to these rivers are matters within the control of local or provincial legislatures of the British Colonies, I have brought the subject, and laid several of the letters, informally, before Sir John Macdonald, from whom I understand that the obstructions complained of are prohibited by the Canadian laws, and that the authorities are constant in their efforts to prevent their being placed in the river, and patrol the river for that purpose, but find it very difficult to prevent violation of the laws on this subject. He has taken the letters, and assures me that no efforts will be wanting to prevent or to punish future violations.

Very respectfully yours,

HAMILTON FISH.
New Members.

In the course of the year, I took occasion to write to most of the practical fish culturists of this country, whose acquaintance I had made by correspondence, or otherwise, to the number of about 200, extending to them an invitation to join the association.

These letters met with various replies; some few were not answered at all, but they were, on the whole, well received, and the replies in most cases contained expressions of interest in the prosperity of the association.

Correspondence.

During the year, I have received various letters addressed to me as secretary, to two of which I wish to call your attention.

One was a letter from a gentleman whose name I have lost, who made the excellent suggestion, as I thought, that the association undertake the experiment of taking and hatching, in the usual artificial way, the eggs of the blind fish of Mammoth Cave, to see what effect it would have, if any, upon the sight of this curious fish.

I immediately wrote to parties in that vicinity, and in reply, received a communication from Dr. W. M. Allen, near Louisville, Ky., saying that these fish spawn about the first of April, that they are perfectly white, have no eyes, do not exceed seven inches in length, and that it is doubtful whether they would live in the light; also that Col. Proctor, the lessee of the cave, would probably assist in the efforts to obtain the ova of this fish.

I think very highly of this experiment as one of unusual scientific interest, and would recommend to the Society, when a convenient opportunity presents itself, to take measures to solve this very interesting problem, of hatching and rearing the blind fish of Mammoth Cave in the light.

Another letter of interest, which I received, was from a gentleman in St. Louis, in relation to the different names which are given to the same fish in different localities.

This gentleman stated in his letter that in the course of a rather extended fishing experience, in the southern, western and north-western States, he had noticed the following confusion of names, viz.: The black bass is called, in the southern States, a trout. The rock bass of the east is called a goggle-eye in the west. The silver perch of the south is called in Missouri a croppie, and in Kentucky by still another name. The pickerel of the north is called a jack in the south. Many similar instances might be given.
This ambiguity and confusion of the names of fishes has, I have no doubt, impressed all of us with its inconvenience and objectionableness. I have no measures to recommend to the Association to obviate it; for I suppose it is too extended an evil, and too deeply rooted, to be reached by us; but I think it is deserving the attention of the association, and would suggest that a partial remedy might be found in occasionally collating the various names of each fish in different localities, and publishing them in connection with the Latin or scientific names of the fish, with, perhaps, some description of it added.

Notice of Second Annual Meeting.

During the month of December I caused to be printed a notice of the present meeting, and, in the absence of any committee for the purpose, I stretched a point, perhaps, in my authority, in preparing a stated programme of exercises for the meeting. This was in order to bring before your notice the objects which seem most to need your attention.

This notification circular was sent to all professional and amateur fish culturists whose names were in my possession, and the fisheries' commissioners of the various States, and was generally noticed in the newspapers and agricultural periodicals.

In conclusion, I will merely add that, in the course of the year, I have mailed 500 letters on business of the association, and nearly a thousand circulars and papers.

Proceedings of the First Annual Meeting of the American Fish Culturists' Association, held at Albany, February 7th and 8th, 1872.

The association came together at the Globe Hotel, Albany, N. Y., at twelve o'clock, m., on Wednesday, February 7, 1872.

The secretary's report was read and adopted.

On motion of Mr. Livingstone Stone, the constitution was amended by striking out the word "and" after the word "secretary" in Art. III, and inserting after the word "treasurer" the words "and an executive committee of three members." Art. III now reads:

Officers.

The officers of the association shall be a president, secretary, treasurer and executive committee of three members, and shall be elected by a majority vote. Vacancies occurring during the year may be filled by the president.

The president appointed Mr. A. S. Collins, Dr. Jewell and the secretary a committee to nominate officers for the ensuing year, to report in the afternoon, after which the association adjourned till two o'clock, p. m.

At the opening of the afternoon session, the committee on the nomination of officers reported as follows:

President.—W. Clift.
Treasurer.—B. F. Bowles.
Secretary.—Livingston Stone.
Executive Committee.—Seth Green, chairman; J. D. Bridgeman and A. C. Rupe.

The report of the committee was accepted, and the officers nominated were elected for the ensuing year.

A paper was then read by Mr. A. S. Collins on "Spawning Races and the Impregnation of Eggs," after which a box of trout eggs, taken at the Cold Spring trout ponds, by the Russian or dry method of impregnation, was opened by Mr. Stone and examined by the members. Only three out of nearly a hundred were found empty.

A paper was then read by Mr. W. Clift on the "Culture of Shad."

The next paper was on "The Introduction of Salmon into American Rivers," by Dr. Edmonds, after the reading of which the meeting adjourned till seven o'clock, p. m.

At the evening session, Mr. B. F. Bowles read a paper on "Land-locked Salmon."

On motion of Mr. G. S. Page, it was resolved that a committee of four, to include the president and secretary, be appointed, who shall draft and present to Congress, at its present session, a memorial upon the subject of the creation by the government of two or more fish-hatching establishments; one for salmon in the vicinity of Puget's Sound, and the other at some convenient point near the Atlantic.
coast, for the propagation of shad for the purpose of restocking our rivers and streams.

Mr. George S. Page and Dr. Edmonds were appointed on that committee, with the president and secretary.

The meeting was then addressed by Hon. Horatio Seymour, who suggested that efforts be made to introduce Chinese and other foreign fish into this country.

In pursuance of these suggestions, it was resolved, on motion of Mr. Stone, that a committee of two, including the president, be appointed to make arrangements with such foreign countries as are engaged in fish culture for a mutual exchange of food fishes.

Mr. George Shepard Page was appointed on this committee with the president.

Mr. Page then moved that a committee be appointed to take into consideration the matter of publishing the proceedings and papers of this meeting, and that they be authorized to act at discretion.

Hon. Horatio Seymour and Mr. Livingston Stone were appointed on that committee.

The meeting then adjourned to meet at the same place the following morning.

The association met according to adjournment on Thursday morning. In the absence of the president, the secretary, Mr. Livingston Stone, presided. The report of the treasurer, Mr. B. F. Bowles, was read and accepted.

On motion of Mr. A. S. Collins, it was resolved that the initiatory and annual assessment be increased to five dollars, and the treasurer be instructed to send to each new member a copy of the proceedings of this meeting.

The committee on the subject of furnishing a memorial to Congress then reported a copy of such memorial, which was adopted by the association.

On motion of Mr. A. S. Collins, it was resolved that the meeting recommend that the Legislatures of the different States pass such laws as shall encourage and protect pioneers in fish culture.

Mr. George Shepard Page having placed his office in New York at the disposition of the association, it was voted, on motion of Dr. W. M. Edmonds, that Mr. Page's office, No. 10 Warren street, New York, be made the New York city office of the association; after which the thanks of the association were given to Mr. Page for his kind offer.

The association then resolved to hold their next annual meeting on
the second Tuesday in February, 1873, at their New York city office, No. 10 Warren-street.

It was also resolved that a committee of three be appointed to arrange with Prof. A. S. Bickmore, Director of the American Museum of Natural History at Central Park, New York, for a permanent exhibition in the museum of fishes and implements used in fish culture, without expense to the association. Messrs. George S. Page, C. H. Farnham, and A. S. Hatch were appointed on this committee.

Prof. Spencer F. Baird, of Washington, D. C., Mr. Samuel Wilmot, of Ontario, Canada, and Prof. Albert S. Bickmore, New York, were elected honorary members of the association.

The executive committee, together with the other officers of the association, were appointed a committee to prepare an order of proceedings for the next annual meeting, after which the society adjourned.

The following items have come under the notice of the secretary, and are here communicated:

Longevity of Trout.

The age of the venerable trout which was mentioned in this column a few weeks ago as having been examined by Mr. Frank Buckland, has been testified to in the following terms:

The undersigned have lived about Dunlop House for twenty years and upwards. They herein certify that to the best of their belief the trout sent to F. Buckland is the same trout that was put in the well by Thomas Young twenty-four years ago, viz., 1848.

(Signed) ANDREW STEVENSON.

JAMES ROBERTSON.

Dunlop House, January 20, 1872.

This is the oldest well-authenticated instance of trout life that we have heard of, although there are said to be pike and carp in private ponds in Europe that are proved by the dates on the gold rings in their fins to be over a century old, and Gesner speaks of a pike which was 267 years old.


Mr. Buckland, in Land and Water, makes this allusion to the American brook trout in his museum: "The following is a catalogue of the eggs and fry: Salmo fontinalis, or American brook trout, brought over from Mr. Wilmot's establishment, Newcastle, Ontario, Canada, by Mr. Parnaby, of Troutdale Fishery, Keswick. These are beautiful little fish, of about three-quarters of an inch long. They
have almost absorbed their umbilical bag, and will shortly begin to feed. I propose to feed them on the roc of soles. These American fish are much more active (and I was going to write—it may be even so—intelligent) fish than the salmon or trout (Salmo fario). Possibly they have imbibed some of the national American sharpness. I think I shall consult them on the Alabama argument. They are very difficult to catch, even in the confined space of the trough, and they often jump out of the glass siphon tube used to catch them."

This is all right, except the statement of the place where they came from, which is wrong, for all the brook trout which Mr. Parnaby carried to England with him came from our hatching-house at the Cold Spring Trout Ponds, and were packed by us in the egg the day before Mr. Parnaby sailed for England. We will add, as a matter of statistics in relation to long journeys of trout ova, that the eggs, 10,000 in number, were packed in sphagnum moss in a common wooden box about a foot square, on the 20th of November, 1871, at Charlestown, N. H. They went from Charlestown to Boston, 120 miles by rail, on the same day. They remained in Boston over night, and the next morning were put on board the ocean steamer which sailed that day. They had a long passage of eighteen days to Liverpool, and a considerable journey by rail afterwards from Liverpool to Keswick. At the end of the journey two-thirds of them opened in good condition, although some hatched on the way and died, and the byssus generated by these, and by some of the eggs that were killed during the first part of the trip, made great havoc.

Precious Facts.

In speaking of the new method of the dry impregnation of fish ova, two weeks ago, the composer made us say "pre(c)ious facts" instead of "pre(v)ious facts," as it was written in our MSS. The facts are precious enough to the practical fish-breeder, considering that they increase his yearly yield of young stock fifty per cent, and we have no objection to calling them "precious facts," although all we meant to say at the time was that the facts had been previously stated.

Now that we are on the subject again, we will speak of two inferences that follow from these precious facts. One is that since the spermatozoa of the milt remain alive several days when kept from the air and water, a cross can be effected between fish living at long distances apart without transporting the fish. For instance, a trout-
breeder in Kansas can bottle up some milt from his fish in a homoeopathic phial and send it by mail or express to a Massachusetts breeder, who can take a ripe spawner from his ponds and mix the Kansas milt and Massachusetts eggs in the impregnating pan, and so generate a cross between the two fish as well as if the Kansas breeder had sent him, at a great risk, some male trout. The great ease with which this crossing can be accomplished may some day lead to valuable results.

Another inference is that the old theory that a proportion of the eggs ordinarily taken from the spawning trout are immature, and therefore cannot be impregnated, must be given up. We have opposed this theory all through our trout-breeding experience, and insisted that the trouble in poor impregnations was not in the eggs but in the milt, as it has now turned out to be. But the immature egg theory had its advocates in high quarters, and has been very generally received. There can be no question about it, however, hereafter. If ninety-five per cent of the eggs are impregnated and hatched by the Russian method, then not more than five per cent of the eggs are immature, and we doubt if even this small proportion are.

**Hermaphroditic Cod.**

Sir,—There was full-sized cod got here lately, containing roe and milt both well developed. This, I suppose, is what you call an hermaphrodite. The manager of the curing-yard told me he had never met with another similar case in long years of experience in cod-curing.

W. R. (*Land and Water.*)

**Castalia Springs.**

The Castalia Springs in Ohio promise to be one of the great natural water supplies of the country for fish farming—like the Caledonia Springs in New York, or the Ingham Spring in Pennsylvania. The Ingham Spring, it is estimated, runs 3,000 gallons a minute, and the Caledonia Springs as many gallons a second. Dr. Sterling, of Cleveland, writes us that the flow of water at the Castalia Springs, the temperature and the geological formations are nearly the same as at Caledonia. The Castalia Springs are situated near Sandusky, Ohio, and are now owned by Mr. J. Hoyt.

Trout and white fish are being hatched there this season with success.

It should be remembered that it was in Ohio that the first experiments in trout-breeding that attracted attention in America were con-
ducted. The experimenters were Dr. Theodatus Garlick and Professor H. A. Ackley. They brought their parent trout alive 600 miles, from the Sault Ste. Marie, to Cleveland, where they took and hatched the ova. The results were given by Dr. Garlick in a paper read by him before the Cleveland Academy of Natural Science, February 17, 1854.

Rearing White Fish.

In reply to a correspondent about rearing white fish, we will say that it certainly will not pay to raise them artificially, as trout are raised. The best thing to do with the young white fish after the sac is absorbed is to turn them loose into some large pond or lake, where they will grow pro bono publico. Mr. Samuel Wilmot, of Newcastle, Ontario, Canada, has had good success, we believe, in rearing the young fry of the white fish, and if our correspondent would like to retain some to experiment with, we would advise him to apply to Mr. Wilmot for directions about growing them.

The Adipose Fin of the Salmonidæ.

Extract from lecture of Mr. Guelwer before the East Kent Natural History Society, England:

As to the small and posterior dorsal fin of this family being adipose and devoid of fin rays, or, as emphatically asserted by the excellent Yarrell, "in the smelt without any rays whatever," this is not strictly correct. For though in this fish this fin is, as usual in the family, small and rudimentary, not unlike a fatty layer in a thin skin-film, it is quite destitute of fat, and is kept extended by a thickly crowded set of parallel and very delicate rays, extending from the back of the fish upward to the free margin of the fin, and often projecting a little beyond it, as one may witness by the help of an achromatic object-glass of half an inch focal length. These rays are indeed composed of a peculiar glassy and homogeneous matter, like the intercellular part of true cartilage, quite structureless and devoid of cells; nor have these rays any muscular provision for those motions which we know to belong to true fins, neither have the rays of the adipose fin, as we have seen, any resemblance in structure to the bony rays of the other fins. Still, in the smelt at least, the so-called adipose fin is neither fatty nor without any rays whatever.

The Salmon-breeding Enterprise in Maine.

In 1868 we spent three months in New Brunswick, and built a thoroughly-appointed salmon-breeding establishment on the Mira-
michi river, with great natural facilities and a hatching-house 100 feet long. We succeeded in taking that year a quarter of a million impregnated salmon eggs, but the jealousies we encountered there and the strong public opinion in Canada against the operations of foreigners in this line, convinced us that the next time the thing was attempted it had better be done on American soil, as the Canadians call the United States. We were, therefore, very glad to hear last spring of the project of Commissioner Atkins to locate salmon-breeding works on one of the Maine rivers, where salmon eggs could be obtained independently of foreign control.

The scheme of Mr. Atkins has met with a double success, for he has not only succeeded in getting a very considerable quantity of ova at a cost of more than twenty dollars per 1,000 less than is charged at the government establishment at Ontario, Canada, which is one success, but his labors have proved that much larger quantities may be obtained in future years at a still less cost, which is another and greater success.

Mr. Atkins' report is filled, as his reports always are, with very valuable matter, and forms an important addition to our still limited stock of knowledge on the culture of fish. We should like to reprint here seven-eighths of Mr. Atkins' report, word for word, but as there is not room for this we will confine ourselves to the following extracts:

The most important business of the year has been the breeding of salmon from parent fish obtained in the Penobscot river, less attention having been paid to the construction of fishways than in former years, and nothing at all having been done in the cultivation of fresh-water fishes.

Our plan was as follows: To buy live salmon of the fishermen in the vicinity of Bucksport, transport them to some convenient place where they could be confined within a small space in fresh water, and keep them until the spawning season, when their eggs would be taken. All the eggs were to be developed on the spot sufficiently to insure their safe removal, and a portion of those belonging to Maine to be hatched out and turned into those waters to assist in increasing the number of salmon in the Penobscot, which would thereby become better able to afford us parent salmon in the future. Among the advantages which this plan would have over that of catching the parent fish on their spawning ground in the fall, three deserve mention. In the first place, we would beyond question obtain a large number of salmon from the owners of weirs, while it was a matter of great uncertainty how many could be caught in the upper waters where
they spawn. In the second place, we should be within easy reach of railway and steamboat transportation, while the spawning grounds lie in the wilderness. In the third place, the spawn that we should take away would not detract anything from the natural increase of the species in the river, since we should use for parent fish only those that would otherwise have gone to the markets, and the accustomed number of adult fish would still be left to deposit their eggs without molestation. The results of the experiment are the eggs actually obtained, and the important addition to our stock of knowledge on the subject of salmon breeding.

The eggs cost the subscribers to the fund $18.09 per thousand. The price demanded and received at the Canadian governmental establishment at Newcastle, when I purchased salmon eggs of them in 1870, was forty dollars, gold, the eggs of a single fish costing several hundred dollars. The prevailing price of parties operating in New Brunswick has been twenty dollars per thousand for eggs warranted to be fecundated. When the extraordinary mortality among the salmon we intend to use as breeders is considered, it is remarkable that the eggs taken at Orland did not cost more. I have no doubt that, with the advantage of this year's experience, they can be obtained hereafter at an expense not exceeding eight dollars per thousand. The experiment has decided in the affirmative the following questions, viz.: 1. Whether salmon can be kept in confinement in a small enclosure from June to November. 2. Whether they will, under such conditions, develop their spawn and milt to perfect maturity. It has also determined the conditions of safety in transportation and to a sufficient extent for practical purposes, the conditions of safety in keeping them through the summer, and finally the best mode of manipulation to secure complete fecundation.

As to the conditions of keeping salmon in safety through the summer, my conclusions may be briefly stated thus: Salmon will live in perfect health in common river, pond or brook water, provided that there be sufficient change to prevent stagnation, that the depth be not less than four feet, and that they be not too much crowded, that the bottom be not newly submerged, that the water be not too transparent; and, in the case of a brook, that there be not a large percentage of water from springs in the immediate vicinity. I have no doubt that some of the salmon that died in the pond, died from injuries received in capture and transportation. But the causes that resulted in the death of so many of our salmon in Craig's pond brook were mainly of a different character. The symptoms were these:
Sluggishness and heedlessness; an inclination to swim near the surface of the water; a white filmy, appearance of the eyes, which seemed to be accompanied or followed in many cases by blindness; a white fungoid growth on the abraded tips of the fins and wherever the scales had been rubbed off; white blotches breaking out on all parts of the body, even where there had been no marks of injury, particularly on the head, proving on examination to be patches of white fungus growing beneath the scales and pushing them from their place; finally death.

The cause is to be sought for among the following peculiar conditions to which these fish were subject: First, the greater part of the water was from springs in the edge of the pond where salmon were confined; second, the temperature was consequently very low, ranging (June 9 to 20) from forty-seven to fifty-four degrees Fahrenheit, while the common temperature of rivers and ponds at that date is from sixty to seventy degrees; third, the extreme transparency of the water may have exposed them to too great an amount of light; fourth, the bottom of the ponds had not been covered with water for several years, and there was more or less vegetation on it. I am inclined to think the latter circumstance the principal source of difficulty.

I have no hesitation in advising that the operations with salmon be continued in the same vicinity. They should be conducted on a larger scale, which, with our present knowledge on the subject, is quite feasible. I think two or three hundred salmon might be bought at Bucksport next season; and, with such success in keeping them as might reasonably be anticipated, more than half a million of eggs might be obtained.

Fish Culture in California.

The great importance of fish culture in this State, as shown by the first biennial report of the State Commissioner of Fisheries, advance sheets of which have been kindly sent us, will attract public attention. It is estimated that the area of the inland bays and fresh water lakes adapted to fish culture exceeds 650 square miles. In addition, nearly 100 streams from the coast range of the western slope empty into the Pacific, and several hundred water-courses unite in the Sacramento and San Joaquin rivers. The whole forms a most remarkable water surface, and, when properly stocked with fish, will be a source of revenue to the State ranking next to our agricultural and mineral resources. The importance of the development of our State fisheries has not been properly appreciated, but enough has already been
accomplished to guarantee the most complete success. The commissioners have undertaken the work as a labor of love, receiving neither fees nor salary. Those large-hearted, public-spirited and benevolent citizens who give their time and thought to the public welfare and happiness deserve to have their names consecrated in the hearts of the people. The present board of commissioners, in the report before us, enter into the subject of fish culture at length. The immense area in which fish may be propagated, the manner of keeping the rivers stocked, the best quality of fish to be introduced, artificial hatching, the way to preserve the water pure, and various other details are minutely set forth. One point is particularly interesting as illustrating the wisdom of nature. By instinct the fish, in spawning season, leave the ocean or bays and seek the particular stream or rivulet in which they were hatched to deposit their eggs. Whatever be the obstacles, they search for a passage, and will die in the attempt to reach their destination or be successful. Where dams have been constructed, it is suggested that fish ladders be constructed to admit them an easy passage. The ladder or fish-way is a trough some four feet wide and three feet high, open at both ends. This they can ascend at an angle of forty-five degrees if provided with rilles or miners' cradles. If the rilles do not exceed four feet, the fish can jump through almost any current. Great stress is laid upon the necessity of legislative action to prevent the wholesale destruction of fish, the obstructions placed in their way, the poisoning of the waters with refuse, sawdust and other material. The Legislature appropriated $5,000 for the use of the commissioners, and a special duty devolves upon it to so legislate that this great interest will be fostered and protected in every respect. With our State waters teeming with fish, we could, in case of our vast herds of cattle perishing from thirst in the future, have an abundant supply of the most healthy and nutritious food known to man.—San Francisco News Letter.

MINK.

The raising of mink can be made quite remunerative by the sale of their fur, as it is a well-known fact that they are rapid breeders, and to any one having a nice stream of spring water, it would be a pleasant pastime and furnish him with "pretty pets."

All that is needed is a small plot of ground and stream.

To prepare the yard for occupancy will necessitate but a very small outlay of money, and the subsequent expense of raising is nominal.
At the age of from five to seven months the mink are worth from five to eight dollars each for their skins.

Not long since we had the pleasure of examining the

**Minkery of Mr. Henry Ressiue, of Verona, Oneida County, N. Y.**

Mr. Ressiue commenced the raising of mink in the spring of 1867, having caught a female mink with young.

Since that time he has raised over a hundred. He sells them for breeding at thirty dollars a pair, including box, and they can be forwarded by express to any part of the country.

The "pen" in which he keeps them consists of an open yard, sixty feet square, surrounded by a common board fence, six feet high, the cap-board projecting inward sixteen inches to prevent his stock from climbing out.

The following is the manner of preparing a yard for a single pair, the size to be twelve by fourteen feet: Having marked off the ground to be occupied, a trench, eight inches deep and fifteen inches wide, is dug around the plot. Flat boards are laid on the bottom of the trench so as to entirely cover it, and posts are set outside the trench. The first board of the fence is nailed base-board style, on the inner side of the posts, with the edge on the flat board at the bottom of the trench. The trench may now be filled with dirt, and the fence completed, boarding up and down. The cap-board should be thoroughly stayed outside and top. More yard room can be added as needed.

To prevent the mink from escaping by the stream, where it enters or leaves the yard, place a goodly quantity of stones about the size of hen and goose eggs at the inlet and outlet of the stream.

**Food.**

Mr. Ressiue states that he has not expended twenty-five dollars in the purchase of food in five years. Any refuse of fresh meat is just what they want, and is equally as good as that which would cost more. Fresh fish is also a good food, and seems to be well relished by the mink.

**Rearing and Feeding the Young.**

Leaving male and female together from March 1st to 20th.
Then separate, placing the male in an adjoining yard.
The young should be allowed to remain with the mother.
Build a small house in the yard and furnish it with plenty of straw.
Give the young ones bread and milk, as you would young kittens, or the mother can care for them.

Mink require hardly any care or attention beyond attention to the food, as they seem to have no enemies from which they cannot protect themselves, are entirely free from disease and not liable to accident.

For the above we are indebted to Mr. Ressigne, whom we found very ready to give information and to show his "pretty pets."

SHAD CULTURE.

By Wm. Clift.

The shad (Alosa pseudohalus) stands very high among, if not at the head of, the luxuries which our rivers afford. A seven-pound specimen, in the month of June, taken fresh from the Connecticut, and cooked by a housewife who has had her birth and education in that famous valley, leaves little to be desired in the way of epicurean delight. The fish from this stream stand so high in the market that the placard, "Connecticut River Shad," probably sells a great many more fish in all our large cities than come from that stream. As compared with the southern shad, they are unquestionably fatter and of finer flavor; but, as compared with the fish that come from other streams along the Connecticut and Rhode Island shores, there is not much ground for the distinction. I have eaten quite as fine shad from the Quinebaug and the Pawcatuck, before the race became extinct in those rivers, as the best ever taken at Saybrook and Lyme.

It is not improbable that they follow the law of the grains and fruits, which show the highest excellence in the northern belt, where they can be successfully cultivated. The coast orange about New Orleans is a higher-flavored fruit than the orange of Havana; the apple of the northern states than those of the southern. The corn and wheat of the north are heavier grains than those of the south. We look for the best shad in the northern limits of the region where they flourish, and in these streams human skill should do its best to multiply the race and increase the supply of food for man.

NATURAL HISTORY.

The shad belongs to the herring family (Clupeida), which afford so large a share of the animal food of European countries. As its name implies, it is the largest of the Alosa, and permanent as an article for food. The species nearest allied to the shad are the alewife (Alosa tyrannis) and the bony fish (Alosa monohodon). The alewife is found
in all shad streams, and in many small streams from which the shad have long since disappeared. The alewife does not need to go so far up the stream to find a suitable spawning bed, and even spawns in the ponds of brackish water. The bony fish probably does not come into fresh water at all for the purpose of spawning. It is sometimes, however, found about the estuaries of our streams, but will not live long in fresh water. They are sometimes cut off from returning to sea by the closing of the tideway at the Charleston ponds in Rhode Island, and always perish during the winter, while the alewife lives. The bony fish are found all along our coast, from the Capes of Virginia to Maine, and form the staple of a lucrative business in oil and fish guano. The geographical range of the shad is from the coast of Florida to the British provinces, and we believe has not been found in any other locality, unless artificially planted. The shad of Europe is a much smaller and inferior fish. The shad resembles the salmon in its migratory habits, but is found much farther south. The salmon probably did not resort to any river south of the Hudson, while the shad entered every considerable stream along our coast north of the St. Marys. They make their appearance on the Carolina coast in February, and in the New England streams in April. Some have supposed that they formed one vast shoal in the ocean and moved up the coast in the spring, giving off a delegation to each stream as they passed by its mouth. But the best authorities now consider that each river has its own family of shad, and that however far it may wander from the month, while it remains in the sea, it is sure to return. The shad of the Connecticut and the Hudson rivers are so different in shape and appearance, that marketmen accustomed to handle them readily distinguish the one from the other. It is probably rare that a shad strays into any other than its native stream. Shad are supposed to feed on soft-shelled crustacea, the young of molluses, small fish and the lower orders of marine life. They have been found with vegetable matter in their stomachs, so that they cannot be wholly carnivorous. As caught in our rivers, nothing is usually found in their stomachs. They stay in the sea, feeding voraciously until the breeding instinct leads them to seek their spawning beds. They then push up the stream with great rapidity until they find their birth-place, traveling hundreds of miles in a few days. Fresh run shad are sometimes taken at the head of tide water, fifty or more miles from the sea, with fishes in their stomachs so little digested that their species could be determined. The same shoal does not probably remain long in the stream. As soon as the spawn are dropped they return to the sea, so much
exhausted that "a down-stream shad" has become a proverb for leanness. The fishing season in the Connecticut is from the 15th of March to the 15th of June; but fish come into the stream earlier, and some probably do not spawn until the last of July. Those used by the Fish Commissioners for artificial propagation are taken mainly in the three weeks following the 15th of June. The shad of the Hudson occupy about the same time as those of the Connecticut in depositing their spawn. At least four months are occupied by the different shoals in performing this office. The favorite spawning grounds are immediately below rapids, like those of Bellows Falls, and Hadley Falls in the Connecticut. Here there are many eddies and side currents, where the spawn are kept in constant motion, before they are carried off by the main current. It seems highly probable that nearly all the spawn that supply the Connecticut are dropped at Hadley Falls. There is no good place for the capture of ripe fish below, and many of the fish taken there have all the marks of fresh-run shad, and are but a few hours from the sea, though they have come seventy miles or more. It has been ascertained by those who have watched the operation, that the males and females, in spawning, swim about in circles, probably following the eddies of the stream, sometimes with the dorsal fins out of the water; when suddenly the whole shoal, as if seized by a common impulse, rush forward and shoot out clouds of milt and spawn into the water. The alewives observe the same method in spawning, though they select ponds and still places in the river for their beds. The most common term for this operation, at the alewife fisheries, is "shooting the spawn," showing that the process is a matter of common observation. The cova, left to the care of water, are mostly devoured by fish that lie in wait for them. It is estimated that not one in a thousand ever comes to life. Those that hatch are gradually carried seaward by the force of the current, and by October and November leave the river as young fish, from four to six inches long.

We have learned almost all that we know of the natural history of this fish, since its artificial propagation was undertaken at Hadley Falls, in 1867. Many of the erroneous opinions held by old fishermen upon the rivers have been dissipated, and certain facts are well established, though much yet remains to be learned. It is now known that the life of the shad, instead of being limited to one year, extends to five, and probably to ten or twelve years; that the "chicken shad," as they are called among the pound fishermen, instead of being a distinct species, are the yearlings of the _pseudolittis_;
that the males are ripe at a year old, and come into the rivers, led by the sexual instinct, while the females are not fecund until the second year, when they make their appearance as small sized shad; that they reach a merchantable size, or a weight of about four pounds, in three years; that at this age they have spawn in the ovaries of three distinct sizes, plainly apparent, and the microscope reveals others still smaller in reserve; that only the larger eggs, or about one-third of those visible, are spawned, while those that remain are the crops for the two succeeding years; that the spawn of a full-grown shad, the ovaries weighing thirteen ounces, is about 70,000 in one season.

The operations of Seth Green, at Hadley Falls, in the summer of 1867, mark a new era in fish culture. When it is considered that Mr. Green was a pioneer in this work, and had only his experience in hatchling the ova of the Salmonidae to guide him, his complete success in a single season must be regarded as marvelous. This story is told so well by Mr. Lyman, of the Massachusetts Fish Commissioners, that we copy from his report of the year:

"Green began his experiments the first week in July. He put up some hatching troughs, like those used for trout, in a brook which emptied into the river; and having taken the ripe fish in a sweep seine, he removed and impregnated the ova, as is usual with trout spawn. 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 thirteen degrees below the temperature of the river (sixty-two degrees to seventy-five 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 replaced them by a wire gauze. In this box the eggs were laid, and it was anchored near the 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 larvae of mosquitoes in 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 cent, while often it would hatch only seventy or eighty per cent. The spawn-box he at last hit upon, and is as simple as it is ingenious; it is merely a box with a wire
gauze bottom, and steadied in the water by two float-bars, screwed to its sides. 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 10,000 placed in this contrivance, all but seven hatched. In spite of these delays, and the imperfect means at hand for taking the fish, Green succeeded in hatching and setting free many millions of these tiny fry."

This simple contrivance of Green's is one of the most important discoveries of modern times. Its grandeur will be much better understood ten years hence, when it shall have been applied to all our shad streams, and the yield shall have been increased, some thirty, some sixty, and some a hundred fold. We do not see why the increase may not be, under favorable circumstances, a hundred fold. In the natural process not one egg in a thousand comes to life. By artificial propagation nearly ninety-nine per cent are hatched, and thus the most perilous time in the shad's life—the embryo period—is bridged over. It is estimated, by those who have carefully studied the subject, that one-fourth of the fry bred in a stream return from the sea. If anything like this proportion escape the perils of the sea, the task of filling our rivers with shad is an easy one. The fry are now hatched at a cost not to exceed ten dollars a million, and the process will become very much cheapened as the parent fish become more plenty. The process as yet has only been fairly applied in the Hudson and Connecticut rivers; and with more spawners and more money ten times as many fish could be turned into these streams every year. Only a small part of the breeding grounds of either of these rivers has been opened. Yet, with the limited application of this discovery made the past five years, there has been a glut of this fish in the markets where they were sold, the finest fish selling for ten cents each. If the State Legislatures will but place sufficient funds at the disposal of our Fish Commissioners, every stream on the Atlantic seaboard can be so filled with shad that they will sell at all the fisheries for one cent a pound within the next ten years. This cannot fail to affect the price of all other fish, and all other animal food. Cheap food under our institutions means the elevation of all the laboring classes, a great increase of their comforts and luxuries, and the improvement of their social and moral condition.

We had the pleasure of witnessing the process of taking the spawn
and hatching it, as it was performed by Mr. Smith, at Hadley Falls, the past season. The scenes are drawn only at night, and there are three hauls made between eight and twelve o'clock, at intervals of almost an hour, because it is found that no ripe shad are taken by day. From one to two hundred fish were taken at each haul, the female fish increasing with the lateness of the hour. As soon as the shad were hauled to the shore, they were taken in large baskets to the pan, where they were stripped. Two men held the fish over the pan, while Mr. Smith stripped the most of them in less than a minute each. Some of the males were not ripe, and were not stripped at all. As fast as they were finished they were thrown into the pan and sold to hucksters, whose wagons were waiting for them. The fishing had ceased at all the places below, and the spawners were very plenty. The milt was brought into contact with the spawn by gentle stirring with the hand, and the contact of the two was so instantaneous, after the emission from the parent fish, that few eggs could escape impregnation. The eggs swell immediately after impregnation from 9-100 to 13-100 of an inch in diameter, nearly doubling their bulk in the vessel. Another very curious fact is the sudden sinking of the temperature of the water, about ten degrees, in which the eggs are suspended. After the eggs have remained a half hour or more in the pans, they are carefully washed and placed in the hatching boxes, which are suspended in long rows from a boom fastened across the current of the river.

From what has actually been accomplished in the Hudson, the Connecticut and the Merrimac, there can be no reasonable doubt about the restoration of shad to all our depleted and barren rivers upon the Atlantic coast. I think we have every reason to expect that the great rivers of the Missouri and Mississippi valley can be abundantly supplied with this fish. A pioneer movement was made in this direction some twenty years ago, by Dr. N. C. Daniell of Savannah, Ga., and an account of it was given by him to the Academy of Natural Sciences in Philadelphia, and is found in their proceedings. He says: "Having long doubted the generally received theory of the annual migration south from the northern seas of the white shad, and of the consequent annual migration this way of the young fry hatched from the eggs deposited by their parents in our fresh-water streams, I made inquiry of our fishermen, and learned that while but distinctive differences were readily detected between the shad taken in the Savannah river and those taken in the river, eighteen miles south of the Savannah. Fully so. fact, I readily concluded that the

\[ \text{Fuller info here.} \]
never go so far from the mouth of the river as to lose their connection with it, and that they ascend in the spring the same river which they had descended as young fish the previous summer. Then the feeding ground, so to speak, is in or near the mouth of the river. If the young shad does attain its growth at the mouth of the Savannah and of the Ogeechee rivers, may there not be equally good feeding grounds at the mouth of the Alabama and other rivers flowing into the Gulf of Mexico? To solve this question, I, with the aid of my friend, Mart. A. Cooper, Esq, whose residence on the Etowah river, in Barbon county, supplied an eligible locality for the experiment, in the early summer of 1848 had placed in a small tributary of the Etowah river the fecundated eggs of the white shad, which I had myself carefully prepared at my plantation on the Savannah river, ten miles above this city, from living parents. These eggs so deposited by Major Cooper, were daily visited by him until they had all hatched. In 1851 or 1852 the white shad were taken in the fish traps at the foot of the falls of the Alabama, at Wetumpka, and of the Black Warrior, near Tuscaloosa.

"Through the kindness of a friend at Montgomery, Ala., a shad taken from the Alabama river was sent to Prof. Holbrook of Charleston, S. C., who pronounced it the white shad of our Atlantic streams. They have gradually increased in quantity since they first appeared, and have, year by year, increased in size, until they are now equal to the best Savannah river shad."

"The white shad have chiefly been taken in the traps at the foot of the fall at Wetumpka, and near Tuscaloosa. One, I am informed, has been taken from a trap at the head of the Coosa river, near Rome, in this State; and only some sixty miles below the locality in which the eggs were deposited by Major Cooper in a tributary of the Etowah river; I also learn that some few have been taken with a dip net near Selma."

"I think we may safely conclude that the white shad may be as successfully established in the Mississippi river as it has been in the Alabama. Since feeding grounds for that delicious fish exist at the mouth of one river flowing into the Gulf of Mexico, may they not exist at the mouths of other or all the rivers discharging into that

Time must answer that question."

"I think there can be very little doubt of the success of the effort to establish shad in all the streams that empty into the gulf. They are abundant with the shad streams of the Atlantic coast, near the Alabama. If the shad can
have good breeding grounds in tolerably clear water, I apprehend there will be no difficulty from the amount of soil held in suspension in the lower part of the river. The fry will remain in the clear water, if that suits them better, until they are prepared to migrate to the sea. If Congress should favor the memorial that we propose to make, and grant an appropriation for fish culture, the experiment of planting shad in western waters can be tried the coming season. It will cost but little, in any event, and if it succeed, it will give cheap fish to all our western States and territories, and supply one of their greatest wants.

**SPAWNING RACES FOR BROOK TROUT**

Read at the annual meeting of the American Fish Culturists' Association, February, 1872, by A. S. Collins.

All spawning races now in use may be divided into two classes. The first used for getting fish in a ripe state for the purpose of obtaining and impregnating the eggs artificially, and the second used for obtaining the impregnated eggs as laid by the fish. The races of the first class for artificial spawning are simple in construction. They should be made about four feet wide, not less than thirty feet long, and the depth of the water over the gravel varying, with the size of the fish, from six to twelve inches. (As I am speaking to practical fish-breeders I do not enter into details, which they will all understand.) There being no gravel in the ponds, the fish will enter into these races during the spawning season only when ripe or nearly ripe. The eggs can be easily taken from nearly every fish pond at any time in these races. They can be impregnated, and will make as good and healthy fish as if laid by the trout themselves. No moderate pressure will force the eggs from a fish unripe or even nearly ripe.

The races of the second class, or those used for obtaining the naturally impregnated eggs of fish, are of much more complex construction. These races are of two kinds. In the first the eggs are left to hatch naturally, the fish being excluded at the end of the spawning season. The simplest form of these is made by screening off the upper part of a spring brook, allowing the trout free access to it during the spawning season, and driving them all to the lower part of the stream as soon as the season is closed. The eggs above have then a chance to hatch, and the young fish to develop, the screen being made fine enough to prevent the young fish from passing through. This arrangement seems to be very simple, but is rather difficult to put in practice for several reasons. It is hard to get the screen down so that the
water shall pass only through it, and as the meshes are necessarily fine, the screen must be large in comparison with the volume of water to pass through; and, when right in all other respects, it is liable to be constantly clogged by floating particles of moss, weeds, leaves, etc., and must be carefully watched and cleaned. The plan may answer well enough for one who wishes to produce only a small supply of fish annually, but the plan will not answer for any one who wishes a large supply, and that most of the eggs laid should produce fish, because only those eggs will produce fish which are laid so that the water shall constantly pass round them, and the fact being that only those laid over the spring itself, or in a strong and shallow current, are placed in these conditions. The favorable localities being limited, the fact is that comparatively few of the eggs hatch. Furman's patent race, or "brook shanty," as he terms it, obviates these difficulties. A ditch is dug, say two feet deep, four feet wide, and several hundred feet long. The sides are made of boards. At the distance of five or six inches from the bottom a cleat is nailed to each side. Upon these cleats are laid cross pieces of planks about three inches wide and four feet long. These cross pieces are not laid close together, but have an interstice of one-quarter or one-eighth of an inch. Upon these cross pieces gravel is laid to the depth of four or five inches. Now, then, if at the head of the race a partition is made to run across the race from the top to within six inches of the bottom, it will be seen that all the water will be delivered under the planks supporting the gravel; and if at the end of the race a tight bulkhead is made reaching from the bottom to within four inches of the top of the race (or in other words twenty inches deep), it will be seen that the water can be let out only after rising from the bottom through the cracks in the planking, percolating evenly through the gravel, and rising to a height of about six or eight inches above it. The height being regulated by the height of the bulkhead at the end, it will be seen that this forms an artificial spring, the water rising up through the gravel and being equally distributed throughout the whole length of the race. The advantages claimed for the race are that it dispenses with a hatching-house and the labor required there, and that it can be used in any place where there is a spring of water or marshy ground, or by the side of a stream. It is claimed that the fish thus hatched are more healthy, and, when properly fed, show no extraordinary tendency to die during infancy. The disadvantages of the race are that not so many of the eggs are hatched as by other methods, that they cannot be cared for as in
accessible troughs, that the trout will disturb each other's beds and eat more or less of the eggs, and that no eggs can be gathered for transportation elsewhere. Of course I cannot here enter into a full discussion of any race, as the subject is too extensive, but can only indicate some prominent points. The above-mentioned, so far as I know, are the only kind of races used for the production of the fish without collection of eggs into hatching-houses. The second class of spawning races are those made for the purpose of obtaining the eggs after the fish shall have laid and impregnated them in the natural manner. These, so far as I am aware, are all either constructed on one principle or are modifications of that principle. The idea underlying them all is the natural spawning race invented by Stephen H. Ainsworth, who deserves to be called, as he often is, the "father of fish culture in America." I suppose, of course, that you are all familiar with the construction of his race: the wire screens being made in the shape of double boxes two feet square, each set being taken up separately and the eggs removed. Now, this was a great step, so far as it went. I myself do not believe that the naturally impregnated eggs are better in any respect than those taken artificially. Opinions vary, and the question is not yet definitely settled; but be this as it may, every fish-breeder will have more or less use for some screen of the kind. Those who believe only in the natural impregnation will have them of course; and those who, for any reason, prefer artificial impregnation will still need such a screen in their races to gather the eggs which will inevitably be dropped in the intervals of taking. The practical difficulty in the use of Ainsworth's screen, as invented by him, is that each of the two-feet boxes has to be taken up separately, the top boxes set on one side, and the eggs feathered off the lower screen into a pan of water. As this must be done under water, the operation is neither pleasant or endurable in very cold weather. Then, again, the gravel has a great tendency to get out of the boxes, and between them and on the eels, rendering a great deal of poking necessary before the box can be put back again into its proper place; also, the time consumed would make a great deal of help necessary to the fish-breeder, and not only much, but skilled labor, which it is almost impossible now to find. Besides, the fish are driven off the race back into the pond every time the race is taken. For these and other reasons some modification of the Ainsworth plan is absolutely necessary to every one who breeds fish on a large scale. The modifications which have come to my notice are as follows: In the "draw
plan” a race is first made containing a single row of Ainsworth screens; a parallel race of the same length is made by its side. This is a blind race, or one into which the fish cannot enter. The upper screens in the first race are made stationary, and the under screens are so placed on slides that they can be reached from the parallel race and drawn out into it. This arrangement does away with the removal of the upper screen, the displacement of gravel, driving away the fish, saves some time, and is so far an improvement. But it does not obviate the other difficulties. There is still too much working in cold water and too much time taken, and a double race is rendered necessary. Another modification of the Ainsworth race is what I should call the hook-and-eye slide. The upper screens are made stationary, as in the former case. Cleats for the under screens are made along the whole length of the race. The under screens are made as usual, except that two hooks are fastened into one side and two eyes into the opposite side. Then the operator, standing at either end of the race, slides in one of the under screens, placing the eyes toward him. Taking another screen, he fits its two hooks into the eyes of the first. The second screen pushes the first further in, and so on to the end. When the race is to be drawn, the first screen is pulled out its full length, unhooked, and the eggs are taken. The second is thus brought into reach, pulled out, unhooked, etc. This race takes up less room than the former; but its screens are also ten or twelve inches under water, and the contrivance, like the other, is clumsy, unhandy, and requires too much labor. The other modification of the Ainsworth race is my own patent roller screen. This has been in use for three years at our establishment (Seth Green and A. S. Collins, at Caledonia, N. Y.), and we still think it the best thing for the purpose. In this contrivance the race should be made about four feet wide and thirty feet long. The upper screens, instead of being made single, are made in sections of any convenient size. A roller is fixed in each end of the box, under the upper screens, and, instead of under screens, an endless apron of wire-cloth is made to pass over the rollers the whole length and width of the race. An apron, twenty-five or thirty feet long, would be liable to sag in the middle, but cross pieces are fastened to it, which slide upon cleets nailed to the side of the box, and the whole upper side of the apron is kept at a distance of one inch from the upper screen. Two cog-wheels are connected with one of the rollers, by means of which it can be turned from above with a common crank handle; and also a tin pan, four inches wide and four feet long, or better, four pans of a foot each, set into a light
frame. When the eggs are to be taken a small gate in the front part of the box is raised, the frame of the pans lowered in front of the forward roller, and the crank turned. The crank turns the roller, the roller, by friction, turns the endless apron, and as the eggs on the apron come forward over the roller they drop into the pan. When the apron has been turned one-half round the eggs are all off. The pan is lifted out, the gate shut, and that is all till next time. It does not require ten minutes to take the largest race, and the hands are absolutely free from any contact with the water. For these and other reasons, not necessary to mention here, I claim that this is the best form of the Ainsworth race. The great disadvantage of the whole series is that they take so much more room than the race for taking artificially impregnated eggs. Into the latter the fish crowd as the best place to spawn, and are daily taken out, thus making room for others. In the Ainsworth they must have room actually to perform the operation, and as each pair practically use from twelve to twenty-five, or more, square feet, a large pond must have several of these races, in order to secure all the eggs.

I have endeavored to present a few facts relating to my subject in as brief and compact a manner as possible. It will be seen that the minute of fish breeding are studied very closely in this country. But, from the very nature of the case, it will still be many years before the best plans are definitely settled and accepted.

THE INTRODUCTION OF SALMON INTO AMERICAN WATERS.

A paper read before the American Fish Culturists' Association, at its first annual meeting, held at Albany, N. Y., Feb. 7th and 8th, 1872, by Dr. M. C. Edmonds.

The subject of the "introduction of salmon into American waters" having been assigned me by the president of this Association, I shall proceed, without very many preliminaries, to give you what I have gleaned upon that subject.

It is well known to you that the question of salmon culture, and the introduction of salmon to our rivers is yet in its infancy, and nothing sure and certain has resulted from our labors thus far, so that really the matter yet remains an experiment with us. England, in less than half the time, has accomplished much, goes on in the work successfully, and now reaps a rich harvest from her labors. It is true that we have been as faithful laborers in the field as she, and I dare say should have been as successful had our efforts been as individual-
ized as theirs. Why she accomplishes so much is the fact that associated individual effort always does the work in the quickest possible manner, while the work in America has been under the auspices of State legislation, and confined to a few quite impracticable men like myself. The work accomplished in England is for the few, while here in America the work is for the many. The rivers there are individual and corporate property, while with us it is the property of the eminent domain, and consequently the stocking of our rivers is very slow and uncertain. A few States in New England have begun in the work, and have labored as well as they could under the encouragement they have received. They conceived it to be the work of the State instead of the work of the individual. So we find such men as Geo. P. Marsh, of Vermont, and A. H. Robinson, of New Hampshire, making a lengthy report, almost simultaneously, to their respective State Legislatures upon the subject of restocking the rivers with migratory sea fish.

These reports were made as early as the year 1857, setting forth what the Old World was doing in the matter of fish culture, and that like results could be effected with us. Yet nothing was done by the Legislatures till much later. Trout breeding was first engaged in by individual effort about this time, and seemed to engage the whole attention of the public, and nothing more was done about the matter of migratory sea fish till 1864 and 1865, when several of the New England States passed sundry resolutions touching the matter. Fish commissions were appointed, concurrent legislation had, and the enterprise set agoing. From one to two years was spent by the fish commissions of the States in perfecting the laws touching this matter, making themselves acquainted with the business before them, and finally, in 1866, starting Dr. Fletcher, of Concord, N. H., for adult salmon, in New Brunswick.

The doctor writes me that "in August, 1866, I went to New Brunswick, accompanied by Arthur Fletcher, of this city (both of us employed by the commission), for the purpose of transporting some of the adult salmon alive, intending thereby to restock our rivers with that fish; but were unable to procure them in suitable condition for transportation at that time."

From the account given by Dr. Fletcher, it seems that he alone was the first man who started out in pursuit of the salmon, yet Mr. Norris tells us that "the first attempt at breeding salmon artificially in the United States was by James B. Johnson, Esq., of New York city, who imported ova of the salmon from the Danube in 1864, and
hatched them in New York city by Croton water," but they all died "from preventable causes when liberated." Let this matter be as it may, it was certainly a failure in the introduction of salmon into American waters. Dr. Fletcher writes me: "In September, 1866, I again went alone to New Brunswick for the ova of the salmon, and succeeded in bringing home some twenty or twenty-five thousand impregnated ova." Of these a large number were put into the Merrimac river, at Woodstock and Thornton, N. H., without being artificially hatched, and whether all or even any salmon fry were hatched out, the doctor is unable to state. A few hundred, and the remainder of this lot of eggs, the doctor hatched out artificially, at Concord. He writes me: "I kept and hatched a few hundred for the purpose of studying them during the period of incubation, and also observing their changes and growth after hatching." Also, "I saved specimens of them when hatched, fifteen days old, one month old, and once a month up to a year old; and when sixteen months old I placed the remainder of them in the Pemigwasset, at Compton, by order of the commissioner." These were the first salmon placed in our waters that I have any knowledge of, and being placed there at sixteen months old they must have been quite large smolts — almost approaching the period when some of them were about putting on the grilse character. Supposing them to have hatched out as early as February, 1867, the sixteen months following their birth would have made it June, 1868, when they were placed in the Pemigwasset, at Compton. This, the first real undertaking of the kind, was a success so far as the introduction of the salmon into our waters was concerned, and if any definite knowledge could be had with reference to the eggs which the doctor put into the Merrimac at Woodstock and Thornton having hatched, we could date their first introduction as early as March, 1867. The opinion is favorably entertained that quite a considerable number did hatch of those left in the waters of the Merrimac at Woodstock, and that we may safely reckon the spring of 1867 as the correct date of their introduction to American waters. Be this as it may, no after consideration of their return has confirmed the opinion entertained.

In 1867 he writes me: "I again went to New Brunswick for another lot of salmon ova, and succeeded in bringing home as many as I could pack in four champagne baskets, 100,000 or more." One-half of these were distributed by the commission to Robinson & Hoyt, of Meredith, N. H., and the other half to Livingston Stone, of Charlestown, N. H. Only twelve per cent of this lot of eggs were impregnated, and about ninety-nine per cent of the impregnated ones
hatched. Mr. Robinson reports his lot to be 5,000, which were put into the Merrimac river, as also were those hatched by Mr. Stone, the entire yield of those eggs being 10,000 salmon fry.

In the year 1868 Mr. Livingston Stone built the salmon-breeding establishment on the Miramichi river, N. B., near the locality where Dr. Fletcher obtained his first and second stock of salmon ova.

Mr. Stone succeeded in bringing home that year, 183,000, as he writes me, which were hatched in various localities, mostly, however, at his establishment in Charlestown, N. H. These were mainly distributed in the Merrimac river. Some of the eggs were hatched by Mr. Brackett, fish commissioner of Massachusetts, and turned into the Mystic river, in that State, and 1,500 by Bacon & Co., which were put into streams near Cape Cod.

Two thousand young salmon fry from this lot of eggs hatched by Mr. Stone were purchased by Commissioner Hagar, of Vermont, and put into West river, a tributary of the Connecticut river, at Weston, Vt., and Winooski river, a tributary of Lake Champlain. Those placed in West river were under my charge through the early part of the season of 1869. They were placed in that river on the 11th day of May, 1869, in a cove or estuary, into which debouched a cold spring brook. They seemed to thrive well during the summer and early autumn, till the memorable fall freshet of 1869, when they were carried out of their nice little home, and I lost sight of them. Many, however, survived the freshet, and came back into the springs for Winter quarters. Several were seen in the summer of 1870 in adjoining towns. In fact, several were caught in the town below, situated on West river, and, when their character was fully known, returned again to the river. I am told that two out of this lot were caught at Windsor Lock in Connecticut, on their way to sea in 1870.

In the year 1869, Commissioner Hagar, of Vermont, brought from the Miramichi river, N. B., some 40,000 or 50,000 salmon ova, which were hatched at this establishment in Chester, Vt. Out of this number of eggs, nearly or quite eighty per cent hatched and were all put into tributaries of the Connecticut river at Weston, and Chester, Vt. These were all the salmon ova brought into the State that year, and were all hatched and distributed in Vermont waters.

In 1870 there was sent me from the Miramichi river, N. B., about 8,000 salmon ova, which were principally sold and distributed to the commissioners of Maine and Connecticut; although our worthy president, Mr. Clift, of Mystic Bridge, Conn., received his pro rata allowance. These were hatched and distributed to the various streams
in their respective States. Those sent to Mr. Atkins, the commissioner of Maine (out of this year's invoice), were found to be covered with frost when he unpacked them, yet nearly 100 per cent hatched. I think a like result was obtained in the hatching of the remainder of these eggs by Mr. Clift.

In 1870 the fish commissioners of Maine and Connecticut purchased from the New Castle (Lake Ontario) establishment—Mr. Wilnot—some 18,000 eggs, which have been hatched and distributed.

In 1871, Maine, Massachusetts and Connecticut jointly built a salmon breeding establishment on the Penobscot river in Maine, from which a fair amount of salmon ova has been procured, and is now in process of hatching.

The recapitulation and formation of tables showing the introduction of salmon into American waters being, for want of correct data, hard to determine, I have concluded to forbear any summing up of places and data of their introduction.

I think it must be definitely determined that Dr. Wm. M. Fletcher, of Concord, N. H., has the honor of being the first man who successfully introduced salmon to American waters, and who first established the best and only successful method, viz., by ova, as he found the adult salmon could not be transferred.

The places best suited in our rivers for the introduction of the young salmon fry is, in my opinion, where there is a cove or estuary, into which debouches a cold spring brook. The water should be quite shallow and inhabited by no other fish. Even the small dace or minnow of double or equal size should be excluded.

Professor Hagar has seen the dace fry of similar size killing and devouring the young salmon. The voraciousness on the part of the dace, trout or other fish is only evinced when the salmon are first introduced.

When first put into a stream where they are to remain—having been transported from ever so short a distance—they seem very dormant, hardly moving from the spot where you put them. Two or three days after they gradually learn their new position until their latitude and longitude, and commence feeding. It is at this time, and before they commence feeding, that so for the succcassion of them so badly. After getting six or eight months old, they will fight their way as readily as any young fry of that age, and increase in the course of themselves. The best food for them in the early part of the year is the maggot. Take any dead animal—cat, dog, woodchuck, or any other—and suspend it to a pole overhanging your pond, invert your animal,
whatever it may be, and leave him for the flies to blow, and very soon you have the desired food. Carbohc acid will destroy the odor.

Through the first winter they should have cold springs to run into sufficiently large to contain quite a large school of them, as they are inclined to collect into large schools through the winter, and seek water that does not freeze.

I hardly think it best to confine them very long in small ponds when one or two months old. As soon as they begin to feed they might be let loose into quite large ponds in which grows the water-cress, upon which they are said to feed quite voraciously; yet, I am inclined to think they do not feed so much upon the water-cress as upon the larvæ which inhabit it. I have examined the water-cress where trout and young salmon have lived the past summer, and I find it hardly touched. Still, I did see some evidence of its having been nibbled by the salmon and trout, but not to such an extent as to warrant any one in concluding that they lived entirely on water-cress. I notice that small larvæ do accumulate upon the water-cress, and that trout and salmon look healthy when they are allowed to run among it, and that they get quite a portion of their food off this plant.

Water without the least perceptible current is best for them to run in after the absorption of the sac, and the bottom should invariably be of gravel. If the bottom is anywise inclined to be muddy, the screens get clogged, and the water rises, falling over the edges of your pond, creating a current which carries over the salmon fry, and they get lost.

They cannot withstand the least perceptible current. After the absorption of the umbilical sack, all efforts they make in feeding are in the very stillest water. Your screen is loaded with young salmon the moment a current of water is created so as to be perceptible; hence the importance of seeing to this matter early.

It may now remain for me to speak of these results that have attended this enterprise in America; which, I must say, are nothing at all commensurate with the labor bestowed upon them. Of the first salmon fry introduced to the Merrimac river, N. H., no returns have been .3 of a pound. The salmon have been seen and caught going to sea; of sea-salmon returned. Salmon were caught, however, this spring at no migration at Saybrook, the mouth of the Connecticut river, the year that the salmon fry introduced to the river in 1869 were allowed to return. Those in the Merrimac have never returned, owing to the inefficient fishways at Lawrence and Lowell. Mr. Stone in New York that a grilse was caught in the Connecticut
river, opposite Charlestown, N. H., the past summer; but I cannot believe it was one that had been to sea and returned, scaling the dams at Holyoke and Bellows Falls. He must have been a salmon turned into Williams river in 1870 by Mr. Hagar, or one that had escaped from his own fish establishment in 1869.

It sometimes seems to me that what was "everybody's business was nobody's business," and that, in view of our insurmountable dams upon the Connecticut and Merrimac rivers, with insufficient fish-ways, etc., nothing was likely to result favorable to the undertaking of restocking our rivers with the migratory sea fish. Large manufacturing interests have sprung up upon these rivers, and corporations of such magnitude as those of Lowell, Lawrence and Holyoke class must for a long time menace the enterprise and hinder the progress of establishing one of the most desirable objects to be obtained in this country.

The fish commissioners of New Hampshire and Vermont have done with the enterprise till suitable fish-ways are provided over the insurmountable dams on the Connecticut and Merrimac rivers in Massachusetts. Yet the other New England States might do considerable in small rivers debouching into the ocean, upon which there are no high dams or other impediments to the return of the fish. New Jersey and Pennsylvania are having concurrent legislation toward restocking the Delaware river with salmon and shad. And I see no cause why favorable results may not be obtained, as there are no large dams upon that river, nor large manufacturing establishments to hinder the progress and ultimate success of the enterprise.

The great desideratum with Yankee enterprise is, "Does it pay?" and to which all other considerations must bend. I can conceive of no other object so dear to us all as the final success of this enterprise. The stocking of our rivers with the salmon is above price, the great and good work for us all—the final consummation of which will bring blessings to millions of people; establishing the fact that man is not living wholly for self, but making progress in the right direction.

The great fact of its feasibility stares us in the face, and whether we would or no, an irresistible impulse forces us onward, and finally the object must be attained.

Let us labor onward and upward, looking for the success ultimately to be realized.

Although England, France and Germany have done so much, yet it redounds not to the ultimate good of the people, but to the glory of individual enterprise, and the accomplishment of the object with them is the realization of large incomes to individual effort. The
American idea seems to be utterly devoid of selfish consideration, being as it is for all the people, and for their continued prosperity. I conceive of no higher ambition for any man or set of men than the ultimate restocking our streams with the migratory sea fish, more especially the salmon. It at once gives all classes the advantages of cheap and desirable food. And, gentlemen, are we not commanded “to feed the hungry,” and how better can this great duty be performed than by laboring to restock our lakes and rivers with fish of all kinds? To this end let us labor and eventually perpetuate a blessing.

LAND-LOCKED SALMON.

A paper read before the American Fish Culturists' Association, at its first annual meeting, held at Albany, February 7th and 8th, 1872, by B. F. Bowles.

Mr. President and Gentlemen of the American Fish Culturists' Association.—The task you have assigned to me is one that I hardly feel competent to discharge, and I doubt if I am able to do it satisfactorily to you. But it is a task I undertake con amore, for there is no member of the finny tribe I am acquainted with that I regard with so much admiration and delight as the land-locked salmon. I have no idea that I shall be able to tell you anything new about this noble fish, but as it has been an object of study and inquiry with me for several years, and as I have cultivated its personal acquaintance on certain angling excursions to that degree that I may say a strong tie has existed between us, greatly to my pleasure if not to his, I hope, at least, to invest old facts with some new interest.

The fresh-water salmon, which is now generally recognized by the name of the land-locked salmon, is known to exist only in the waters of North America and Scandinavia. On this continent it inhabits five different lake systems of Maine, which, if I am correctly informed, are these: Sebago Lake, both branches of the Saco Diet Lake, Sebec Lake and Reed's Lake. A very small variety inhabits a lake called Loch Lomond, near St. John's, New Brunswick, which are known in that vicinity as "white trout." The origin of land-locked salmon is still an unsolved problem among the naturalists. Some hold that it is the progeny of sea-salmon, and dwarfed by being prevented from making its annual migration to the sea, and therefore compelled to seek its nourishment in fresh water only. From this plausible theory the name is derived. And this name is generally believed to have been bestowed upon this fish by Prof. Agassiz, but I am not able to learn if this is the fact, or if it was imported from Europe, where the
same fish exists. It is doubtful if Prof. Agassiz would give that name to this fish now, at all events. Opposed to this view of its origin is the fact that there does not now exist, and has not existed for many years, any obstacle to the passage of these fish to the sea. At least this is the fact in some localities where they are found. Until within a few years the Schoodic salmon descended the San Croix river as far as Calais, and from this point it is an open run to the sea. But in support of this theory is the fact that both on this continent and in Scandinavia, land-locked salmon are found only in inland waters to which sea-salmon penetrate, or once had access to, in their summer migrations. My friend, the learned secretary of this Association, argues with much skill that the land-locked salmon is entitled to the rank of a distinct species. He claims that its size, robustness and spirit, and above all the difference in the number of eggs it deposits, form sufficient testimony against the theory that this fish is a sea-salmon, dwarfed by the suppression of one of its strongest instincts.

That veteran angler and fish culturist, Mr. Thaddeus Norris, of Philadelphia, says, on this subject, that "many years ago a few sea-salmon finding the large Schoodic lakes to be convenient feeding grounds, passed the winter in them, and their progeny, taking this to be the established habit of their fathers, like the good Pennsylvania Dutchmen, preferred to walk or swim in the same path."

Mr. Norris cites the most authentic instance in which sea-salmon were known to be actually land-locked, and the effect it had on their progeny.

"The first and the least of all are those Lilliputians found in Loch Lomond, which supplies the city of St. John's, New Brunswick, with water. The Mispeck, which discharges that body of water covering about three square miles, twenty years ago was dammed for milling purposes, and some of the sea-salmon which had been migrating to and from the lake, remained and reproduced. The lake being small and of inconsiderable depth, furnished a very limited supply of food, and as a consequence each generation attained a less size than its predecessor, until the descendents of the lordly anadromous salmon are now reduced to the length of nine inches. I have seen strings of them there, and their average size does not exceed this. They are so small as not to deserve the name of salmon, and are called "white trout." Yet they are true salmon; and, if the dams below were taken away, and they descended to sea for as many years as they have been debarred from it, would attain their normal size."
But I leave the doctors to disagree as to the origin of this fish, and pass to other facts concerning him.

In external appearance the land-locked salmon closely resembles the sea salmon, except in size. In anatomical structure they are said to be identical. The eggs are the same size, and the young fry are almost precisely like those of migrating salmon. Between the fry of a few months old of the two species there is scarcely any perceptible difference. It has the jet-black spots of the true salmon on its gill covers. It has the recurved, conical tusk on the lower jaw, peculiar to the true salmon. It ascends the streams at night, and its period of spawning is short, like the salmon. The color of the flesh is the delicate pink of the salmon, perhaps a few shades lighter, but I have never found the deposit of white curds between the muscles, as in sea salmon. It may exist in larger specimens than I have seen. The weight of land-locked salmon varies with the different localities where they are found, and, what is a little singular, the largest fish are sometimes met with in the smallest lakes. Thus the Sebago salmon now average in weight five pounds to the males and three to the females, but larger ones are sometimes taken. The largest on record is seventeen and a half pounds. The fish from Reed's lake weigh from ten to twelve pounds, while those from the Schoodic lakes, which are much the larger range of waters, average one and one-half pounds, and an eleven pound Schoodic salmon is the largest on record. I never saw one weighing over three pounds.

Whatever the origin of these fish may have been, whether they descended from old King salmon or “came over in the Mayflower,” there is no doubt that they can boast of a highly respectable antiquity. There is evidence that these fish have existed in the waters in which they now are found for many years. The Indian traditions of the localities mention them. The spot which is now the favorite camping ground of anglers at the outlet of Grand lake abounds in Indian relics, and there is little doubt that in former ages the Indians encamped on this same spot to pursue their summer sport. Twenty-two years ago Dr. A. C. Haunlin, of Maine, went to the outlet of Grand lake stream with Peale Toma, the celebrated Indian guide. I think this was the first time a true fly fisherman—and Dr. Haunlin is a naturalist as well—ever killed these fish. It was in the month of September. He says that when Toma first threw his rudely made fly upon the water it seemed as though fifty little salmon sprang for it, their silver sides glistening in the pure water like flakes of light. Curiously enough the “untutored mind” of the Indian had formed the same theory
with regard to him as some of the naturalists, for, as he pointed out
the beautiful colors of the dying fish, Tonna said, "there! that fish
brother to salt-water salmon, only he forgot to go to sea, but stay in
fresh-water instead."

The Schoodic salmon run out of the deep water of the lakes into
the outlets and streams both in spring and fall. In the spring they follow
the log rafts through Grand lake in large numbers, attracted probably
by the offal thrown overboard, and the insects falling from the bark
of the logs. The lumbermen sometimes take numbers of them about
their rafts; and in trolling through the lake for trout and toque, I
never failed to take several salmon if I drew near a raft. To me this
fact is the best evidence that a fish cannot hear, for I do not think
any self-respecting member of the salmon family would voluntarily
remain within hearing of the unearthly din that a crew of Maine
"loggers" make in warping a raft through one of these lakes. When
they first arrive, these fish are covered with a thick green slime, which
is believed to be a species of parasite that cling to them during their
long winter residence in the deep water. In this condition many of
them are rather dull and sluggish in their movements, not rising to
the angler's fly with avidity. But a few days, or even hours, in the
quick water of the stream cleans off this slime, and their sides are like
burnished silver. At first they appear in small parties of six and
twelve and a score, till about the first of June, when there are gen-
erally two or three days in which they crowd in thicker and faster,
and the whole family seems hurrying into the stream. Once there,
they remain in its foaming rapids until July, when they return to the
cooler waters of the lake. About the tenth of September they run
into the stream again—this time to spawn. They begin to spawn in
October and finish early in December. The height of the spawning
season is about the fifth of November. It spawns at night and lies
quiet during the day, which is the reverse of the trout. It is at this
season that formerly the Indians speared vast quantities of these fish,
sending them to market in barrels, and packing them up for their
own winter food. It is doubtful if this illegal destruction of these
fish is now entirely stopped by the more stringent laws and efforts of
sportsmen.

It seems useless, however, to waste any regret over the illegal fish-
ing of the past or the present, in view of the impending total ruin
of this most valuable fishery, for that it is doomed to immediate
destruction seems certain. A tannery has been built within the last
year on Grand Lake stream, just about at the point where the salmon
"love to congregate" in spring and fall, which, together with the large settlement that has been formed in consequence, place this ancient and favorite haunt of the Schoodic salmon among the multitude of fisheries destroyed by the intrusion of manufacturing industry. When the purpose of landowners in this region to build a tannery at this point first reached the ears of the sportsmen who were accustomed to visit this spot, it caused a buzz of indignation and alarm, and there arose among them a strong desire to rescue this valuable fishery from the threatened desolation. Two years ago this spring I was appointed one of a committee authorized to purchase land on both sides of this stream below the dam on behalf of the Oquossuck Angling Association—an association of gentlemen anglers already possessing valuable lands and waters in Maine for fishing purposes. But our effort was made too late. It was obviously of more importance to the landowners and inhabitants of the region to have a tannery there than once or twice a year a party of anglers. And they cared little for the fish—indeed they seemed to look upon those who came from such a distance at such a great cost to kill a few of these fish as a parcel of lunatics. I appealed to Mr. Charles G. Atkins, the very able and gentlemanly fish commissioner of Maine, who visited the stream at that time, for his intervention against the tannery; but although his sympathies were with the anglers and in favor of saving the fish from destruction, he said that he was clothed with no power to stop the proposed occupation of this beautiful stream by its owners to develop its water-power. Mr. Atkins regards the fishery as doomed to rapid destruction. The fish may come into the stream in some numbers for a few years, but they must gradually disappear before this invasion of their natural domain by what we usually glorify as the "progress of civilization." But if the Schoodic salmon is to be driven from its native waters, it is likely to be kindly provided with a home where it has hitherto been unknown. Of course such a valuable fish as this for food and for sport could not long be overlooked by the fish culturists. Various experiments have been made, both by individuals and by State fish commissioners, to introduce these fish into other waters, and in most instances it has been successful; though it may be said that these various experiments have not been sufficiently tested by time. It is tolerably certain, however, that the Schoodic salmon will thrive in fresh-water lakes and streams which are favorable to the existence of large brook trout. In October, 1868, Mr. Atkins, the fish commissioner of Maine, took a lot of spawn at Grand Lake stream, part of which was carried
to Manchester, Maine, to be hatched, and part of which was given to
the fish commissioners for the state of Massachusetts. About 3,000
fish were hatched at Manchester, which were distributed in various
waters to take care of themselves, except 800 which were placed under
the care of David C. Pottle, at Alma, a practical trout breeder. Mr.
Pottle has a number of artificial ponds supplied with spring water.
One of these, some two rods square, was allotted to the salmon. In
nine months they increased their size more than sixty-four times,
and probably nearly one hundred times. They were fed daily with
curdled milk, and out-weighed (five to one) fish of the same age that
were taken from their native waters. Of the portion of eggs received
by the state of Massachusetts, about 1,800 hatched; but while the
fish were quite young fry they were accidentally mixed with a lot of
sea-salmon fry, and thus their identity was lost. It is worthy of note
that in this instance a comparison, side by side, of over 100 specimens
failed to show any specific difference between the fry of the sea-
salmon and the land-locked salmon. But the most extensive and best
organized effort to cultivate the land-locked salmon by artificial means
has been undertaken by the president of our Association, Rev. W.
Clitt. The use of the hatching apparatus at Grand lake, which had
been prepared by the commissioners of Maine and Massachusetts, and
the right to take the spawn of Schoodic salmon, was granted to Mr.
Clitt on condition that he should turn back into the stream one-third
of all be hatched. He began his work there with the aid of David
Dresser, of Princeton, Me., about October 1, 1870. Over 700 fish
were caught with the fly. About 256 males and 300 females were
stripped, producing 162,000 eggs, or about 540 to a female. A large
number proved to be unimpregnated. Out of the healthy eggs that
were successfully transported to the hatching boxes at Poquonoc
farm, 9,000 fry were hatched for the State of Connecticut, which
were distributed into nine lakes and rivers in different parts of the
State. Of the Poquonoc Company's fry, 7,200 were distributed in
Broad brook, April 21, 1871. Of the portion of eggs left at Grand
lake, 16,500 fry were hatched and returned to their native waters.

Last fall (1871) Mr. Clitt was not able to continue the collection of
spawn, owing to the occupation of the stream by the tannery com-
pany and the merciless destruction of the salmon on their spawning
beds by its employees, so that his experiment of the year before was
most timely and fortunate. Since the destruction of this noble
fish is permitted in its native haunts, it is one of the most gratifying
results of the science of fish culture that it has been instrumental in
preserving the Schoodic salmon and distributing it into distant and strange waters, where it will be more highly prized and protected. Whether it will lose some of its good qualities by the change remains to be demonstrated.

I should fail to do justice to the land-locked salmon, and also be guilty of the deepest ingratitude to him, if I failed to speak here of his high qualities as a game fish. All truly fishermen who have ever killed the Schoodic salmon speak of it with the greatest enthusiasm. I have heard an old angler say he had rather kill six of these fish than fifty trout of the same size. That "grace and reverend angler," Dr. Bethune, went regularly every spring to Grand lake for many years, and he had right royal sport there sometimes. It has been my fortune to share the camp for three years with George Trott, Esq., of Philadelphia, who was the comrade of Dr. Bethune at the stream for many years, and over our camp fire he has related to me the wonderful stories of those days. From his diary is taken the score of their sport a few years ago: "June, 1856, three rods, six days, 634 fish, 872 pounds; June, 1857, three rods, six days, 432 fish, 642 pounds; June, 1858, two rods, eight days, 540 fish, 725 pounds; one rod, six hours, sixty-five fish, ninety-four pounds." When fish are so plentiful as this, it would seem to deprive the sport of its true zest. But this will never be the case again at this spot. There is a tradition at the stream that a Scotelman crossed the Atlantic regularly every year for several years to kill these fish; and I have no doubt it is true, for one who has ever enjoyed this sport once has a keen relish for it and desires to try it again when the season comes around. The ruin of this noble fishery at Grand lake will therefore be deeply mourned among the anglers. It does seem as if it might have been saved, and been the source of so much wealth to the State and the locality as a tannery.

It is hardly necessary for me to add to this evidence of the high qualities of land-locked salmon, as a food and game fish, that it eminently deserves the attention of fish culturists and those engaged in the promotion of the culture of useful fishes on behalf of the State. It has been shown that it thrives well under artificial treatment, and there is every reason to believe that it will do well in all pure lakes and streams, such as are favorable to the growth of the brook trout.

In their report of 1871, the Massachusetts commissioners say: "The Schago salmon procured last year yielded several thousand eggs, which were successfully hatched. The seven fish brought at that time have lived perfectly well in a spring pond of moderate size, which
shows how easily this large fish may be availed of for the purpose of
culture."

I have purposely omitted mention until now of the salmon of Wil-
mot's creek, Ontario. It is conjectured that this fish is a fresh-water
salmon, and, if so, it stands at the head of the so-called land-locked
salmon. There is no real obstacle, except the distance of 1,500 miles,
to prevent this fish from making the annual migration of its species
to the sea; but some naturalists who have observed its movements
believe that it winters in Lake Ontario. It is my own opinion that
it does migrate. Experiments have been made by marking fish and
otherwise to ascertain if this be the fact, however, and it will pro-
bably soon be demonstrated. Mr. Wilmot's success in the artificial
culture of these salmon is one of the greatest triumphs of the science
of fish culture, and, together with the peculiarly questionable habits
of the fish, has attracted the attention of the world.

TROUT CULTURE.
A paper read before the American Fish Culturists' Association, at its first annual
meeting, held at Albany, February 7th and 8th, 1872, by LIVINGSTON STONE.

The salmon fontinalis, or American brook trout, seems to be espe-
cially adapted to artificial cultivation. Trout become very tame when
domesticated. They can be kept the year round on a simple diet of
raw meat, and they thrive on it. They can be confined in large num-
bers in a small space; they are easily manipulated; their eggs are
hardy and can be transported over great distances with safety. The
grown-up fish are themselves very hardy, in suitable water, and the
per centage of mortality, under good treatment, is exceedingly small.
They are also a beautiful and very interesting fish, in all their habits
and movements. They are the favorite with anglers, and command
a very high price when grown for the market.

These qualities give trout a special adaptation, above all other fish,
to artificial breeding and domestic cultivation, and have made them
the favorite with all who have engaged in fish culture, with facilities
for growing them.

The art of practical trout culture has, however, a very brief history.
It is true that fish culture has been practiced, from time immemorial,
by the southern Asiatics; that it was common among the Romans
before the Christian era; that fish eggs were artificially impregnated
and hatched by a monk in the middle ages. It is also true that a
German army officer hatched salmon and trout about the middle of
the eighteenth century, that experiments of a similar character were
made in Great Britain and Norway and the United States, and that the French organized and kept in operation a large government fish-breeding establishment, till their late disastrous war with the Germans; but it was not—and I say it with pride—it was not till the persevering and far-seeing efforts of Stephen H. Ainsworth, and the wonderful genius of Seth Green, had been directed to the subject, that trout culture passed from the stage of experiment to that of a popular and practical branch of industry.

The history of practical trout culture, by itself, hardly dates back ten years. Without meaning to detract from the merits of Mr. Ainsworth's exertions, which were all the more meritorious because they were, in the practical sense in which he made them, original, I think we can safely say that the art of practical trout culture dates from the time that Seth Green bought the Caledonia stream, and demonstrated to the world what a great success could be made of practical trout breeding. The culture of trout is also an American specialty. In respect to the salmo fontinalis, or common brook trout, it is necessarily so, because this variety of trout is found in no other country. In Europe, however, there is the “salmo fario,” or common trout, the salmo ferox, or bull trout, the salmo trutta, or lake trout, besides the char and grayling, which are closely allied to these; and there is nothing to prevent Europeans from cultivating these fish as Americans cultivate the salmo fontinalis, or American brook trout. But, in point of fact, this is not done. There is one trout-raising establishment in England, one in Wales, two or three in Ireland and Scotland, and these comprise all, in Great Britain, at least. Nowhere, except in America, have the people entered, as they have here, with a universal accord and general interest, into the work of breeding and raising trout.

It seems to suit the American genius. There are, besides the excitement and novelty of it, a magnitude in the scale of operations, and a largeness of results, as well as an absorbing interest in the detail of it, that seems to commend it particularly to the American mind.

At all events, it is a fact that the two great representatives of the art, Stephen H. Ainsworth and Seth Green, are Americans, and it is also a fact that American fish culturists have, with a wonderful unanimity of action, taken the lead given them by these distinguished persons, and have plunged into trout raising with an enthusiasm and universality that have given it the character of a very marked American specialty.
I think it is safe to say that there is hardly an individual, in the north-eastern section of the country at least, who owns a suitable stream, who either has not taken some steps toward stocking it with trout, or who does not contemplate doing so at some favorable opportunity in the future.

The change which it has wrought in the fish itself is very striking. The brook trout, formerly known as one of the very wildest of the wild creatures of the forest streams, has become a domesticated animal.

How fully the word domesticated will finally apply to trout that are bred and grown artificially, time alone can decide. It is still a very doubtful question, whether they will ever become so accustomed and attached to the habitations of man, that they will prefer to remain around his homes and under his protection, like dogs and fowls, and so become in the strictest sense, domestic creatures.

Still this result is not impossible, perhaps not improbable. Cattle, horses, swine, become as wild as buffaloes and zebras, when left to run wild long enough.

Artificial influences have given these creatures their domestic habits. Why may not a sufficiently long course of similar influences create a similar change in the habits of trout?

Again, trout are not afraid of man, when he has not taught them to fear him.

I have seen trout in forests of New Brunswick, as tame as some of my domesticated ones, or, more correctly speaking, as little disposed to be afraid. If, then, we can bring trout back to their original feeling toward man, before they learned to be afraid of him, by teaching them not to fear him, why may we not restore also their original freedom from aversion to him.

Again, I have at my ponds trout that were hatched from parents that were themselves hatched there artificially. Now, it may have been wholly a fancy, but there has seemed to me to be a difference between these fish and the offspring of wild parents in respect to shyness, and that the artificially hatched progeny of domestic parents were less shy than the artificially hatched offspring of wild parents. If this is so, and the trout show an improvement in one generation, what may we not expect of fish in which domestication has been hereditary for many generations?

The time may come when continued domestication, together with the overcoming of their fear of man, may so modify the present action of their instincts, that when pains are taken with the domes-
ticated trout, they will prefer to seek the shelter and food which they find around the houses of man, to the precarious chances of a wild and roaming life. This may not be probable. I do not think it is impossible.

At any rate, whether trout ever come to prey on the haunts of men or not, and remain around them, without being confined, this result has been accomplished—namely, that when artificially bred and confined, they become tame, and thrive and breed even better than in their native freedom.

The subject assigned me on this occasion offers a broad and tempting field, in which it is no easy matter to choose any specified path, for to select any one must be to leave numberless others, no less interesting, untried. At the same time, to confine within the limits of a half hour's reading any kind of treatment of so large a subject, which shall not be wholly superficial, only one or two points can be taken up and considered, and they will represent only a very small fragment of the whole subject.

I shall therefore, even at the risk of a fragmentary production, select two salient points, and confine myself to these.

These two points are (1), the question of the practicability of raising the young fry; and (2), the pecuniary aspect of trout-growing. I select the first, because I think it is uppermost in the minds of the initiated; and the second, because I think it is uppermost in the minds of the uninstructed.

The raising of the young fry trout has been the most perplexing and inscrutable of all the branches of trout breeding. How to hatch the eggs, which really hatch themselves, if simply protected from the dangers which beset them, was a problem comparatively easy in its solution, although this was a grand achievement at first, in virtue of its originality, and reflects great credit on those who pioneered it through; the more so, because it was success in hatching the eggs that first popularized the art of fish culture, and laid the foundations of the present widespread interest in it.

But to make the young trout live, which have equally delicate and more complex organizations than the eggs; to find them the food which is wholesome for them, while it is wholly artificial; to anticipate wants which are not even known; to discover derangements of organs, when the organs themselves are microscopic, and to avert diseases, without a glimpse of their causes; in short, to make creatures live, so frail that a touch will almost kill them, so small that their wants cannot be observed, and that seem to die with-
out a cause; this was a field of study apparently so obscure and intangible that it presented great difficulties. Here the triumphant skill which hatched the eggs successfully was baffled, and it seemed for a time as if the wonderful art which had promised so much was to come to a stand-still at this gulf, between the eggs and the yearling trout, which could not be bridged.

Those who made the earliest practical experiments in this country will undoubtedly recall, with me, the anxiety which was at one time felt, lest the difficulties of bridging this chasm would prove insurmountable. This task has now, happily, in my humble opinion, been performed.

I am a thorough believer in the practicability of raising the young trout. I think the question now is not, how can young trout be raised, but how many can do it, and under what circumstances can it be done successfully.

I know there is a good deal of skepticism in high quarters about the possibility of keeping young fry alive through the first six months of feeding, and I am aware that some of the best authorities say that a considerable per centage will die unavoidably during that time. Mr. Stephen H. Ainsworth, in a letter to the writer, says that a considerable per centage of the eggs, when impregnated, are premature, and consequently produce an imperfectly developed fish, which cannot live.

Colonel Theodore Lyman, in the report of the Massachusetts Fisheries Commission, says, "All remained remarkably healthy till May, when a certain number were observed to be weakly. It is likely that they were naturally sickly, and when the yolk sac was gone, they had not enough vitality to feed."

And Seth Green speaks, in his book on trout culture, as if there were necessarily a great mortality among the young fry, and says, "We don't know what is the matter with them, nor how to cure them."

Now, I wish at the outset to express distinctly my deference to authorities so high—indeed I know of none higher; but I must nevertheless venture to disagree with them, if they mean that there is any necessary inherent cause of death in the young fry, which cannot be removed.

Some will die, say five per cent, though it ought to be less than this, of weak constitutions. They are born into the world so weakly constituted that they cannot stand the wear and tear of life, and must die.
I admit that there may, perhaps, be five per cent of these unavoidable deaths; but that the rest come into being already doomed to premature death, or that young trout have any mysterious or peculiar inherent cause of death in them, any more than young calves or pigs or chickens, I do not believe.

In the present state of information of the art, young trout fry may be more liable to accidents than other young domesticated creatures, and it may be more difficult to guard against their diseases, but this is another thing.

Careless breeding may, and careless hatching certainly will, produce a progeny of young trout, of which 100 per cent will die, but this is also another thing.

Careful breeding and hatching will produce trout which are just as likely to live, in my opinion, as the same number of lambs or chickens; and if the young fry die, it is not because of any mysterious disease, or innate cause peculiar to them because they are trout, but it is because they were killed by external causes, just as much as lambs or chickens are killed by storms or by parasites, or from starvation or poison.

It is true that they are killed from ignorance of their wants, and not from willful neglect, but it is the same thing abstractly; the cause of death is external and removable, and not innate nor necessary.

Their wants are peculiar, of course, and more occult and intangible than those of pigs and colts, and to a beginner it will sometimes seem as if they died when nothing ailed them. But if they were as large as pigs and colts, and could be studied as easily, I do not think their wants would be found to be any more mysterious or peculiar; and if the causes of disease could be magnified so as to be observed and studied clearly, I think that no more trout would die when nothing was the matter with them.

I am furthermore convinced that study and experience will eventually clear up this subject, notwithstanding the difficulties which surround it, and that some time it will be known how to raise trout, and make them live, as well as it is known how to raise turkeys and chickens.

I believe that there are energy and intelligence enough now interested in the cause to accomplish this end; and I think that the beginner may accept these axioms in raising trout:

1. No trout dies without a cause.
2. The causes of death are discernable.
3. They can, in most instances, be removed.
My own experience has invariably been to confirm these principles. I lost, in my apprenticeship days, as many young fry as any one else, but with every death, say over five per cent, there appeared a distinct, assignable cause, present or remote, which could be removed or avoided, and the more I lost, the more I became satisfied that the causes of death among the young fry could be discovered and avoided.

My later experience has added confirmation to this opinion and now, since I have used charcoal troughs and tanks altogether, deaths among the young trout have been, among some lots, rare occurrences, and in general have been no more frequent, over the five per cent weak ones, than among the yearling and breeders.

In one charcoal trough in particular, containing over 5,000, there was, in the season of 1870, less than one and a half per cent of deaths, from all causes, in three months. It was the same in the year 1871. In one box of a thousand, I did not take out ten dead ones in three months. I attribute this, in a great measure, to the use of charcoal in hatching, but it confirms the theory just advocated, that the causes of death can be removed. I think, therefore, that we may lay aside our anxiety about raising the young fish, and with it all anxiety we may have, in any respect, for the ultimate triumph of the art of trout culture.

With a knowledge of how to rear the young fry, all the steps to success in the art are complete. Since the introduction of the Russian or dry method of impregnation, almost 100 per cent of the eggs can be fertilized and hatched. By proper care and skill the young fry can be brought through the first year.

By using the requisite safeguards from poachers, and the natural enemies of fish, the yearlings can be rapidly grown and fattened for market, and the favorite position they occupy among sportsmen, and the money returns which they at present command, are such as hold out the promise of a long period of prosperity in the business of trout growing before it shall, if ever, show signs of decay.

The Pecuniary Aspect of Trout Culture

One of the chief inquiries at the present time, with regard to trout culture, is whether it can be made a profitable business. In reply to this inquiry, I have no hesitation in saying that I think trout raising can be made profitable anywhere in the settled portions of this country where there is plenty of suitable water, but, to be very profitable, it must be on a large scale. It will not pay great profits to
raise 1,000 trout a year, but a handsome income will be made from raising 10,000 a year. I find that the cost of growing trout is very small indeed, and that the returns are very large indeed. It costs no more to keep 1,000 trout each, of the three different sizes, springlings, yearlings, and two-year olds, than it does in the country to keep a horse; and what would keep a pair of horses in the city at a stable, would enable a man to turn out 5,000 pounds of trout a year.

The current expenses of a trout breeding establishment consist of three classes, viz.:

(1.) The rent of the place, or the interest on the original outlay, plus the wear and tear, which together should be reckoned at twelve per cent.

(2.) The care of the fish, which is not much for a small stock of trout, and grows comparatively less, the more fish you have.

(3.) The cost of feed, which is very small, amounting perhaps to three cents a pound; all which items of expense do not make the full grown trout cost over fifteen or twenty cents a pound, if successfully raised. On the other hand, trout bring from fifty cents a pound to $1.25; seventy-five cents being, I should say, a fair average, at the present time, in the neighborhood of Boston and New York.

Here we see a large margin for profit, and I think a fair one, when a man raises his trout successfully, and all depends upon this, of course. If he cannot keep his trout alive and secure, he cannot expect to make anything at the business. I should say the following estimate approximated the truth:

If you have first-rate water facilities, and should hatch 20,000 young fry, and raise them all to be four years old, on food at three cents per pound, they would cost you, after you began to market the fish, not over eighteen cents a pound. If you raise half, all your expenses being the same, with the exception of food, they will cost about twenty-four cents a pound. If you raise one-fourth, they will cost somewhere near thirty-six cents per pound. If you raise one-eighth, about fifty-four cents per pound. If you raise less than this they will cease to pay a profit. To assist the beginner in estimating his expected expenses and returns, I will give the following maxims.

(a.) Under favorable circumstances, five pounds of meat food may be considered an equivalent for one pound of trout growth, with two-year-olds and three year-olds.

(b.) For any given quantity of two or three-year-olds, one per cent of their weight may be regarded as an adequate average daily ration the year round.
(c.) Two and three-year-olds will double their weight annually, and can be made to do so in the six months from April to September, inclusive, by extra care and feeding.

(d.) Good food for grown-up trout, viz.: lungen and plucks of slaughtered animals, can be purchased anywhere for two or three cents a pound. The cost of the actual food for young fry for the first six months is unappreciable.

(e.) First-class trout bring one dollar a pound in Fulton market in April, and can be forced at almost any time when in season at fifty cents.

(f.) Freshly killed trout, well packed in ice and sawdust, will stand a direct journey in the summer by rail of 500 miles, without injury.

Mr. Stephen H. Ainsworth’s estimate of profits, published over five years ago (1866) is as follows:

<table>
<thead>
<tr>
<th>Cost Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of buildings and fixtures</td>
<td>$6,000</td>
</tr>
<tr>
<td>5,000 parents for spawn at fifty cents</td>
<td>2,500</td>
</tr>
<tr>
<td>Three men’s labor for four years, at $300 per year</td>
<td>3,600</td>
</tr>
<tr>
<td>Cost of food for 1,000,000 trout for four years</td>
<td>20,000</td>
</tr>
<tr>
<td>Cost of food for 1,000,000 trout for three years</td>
<td>10,000</td>
</tr>
<tr>
<td>Cost of food for 1,000,000 trout for two years</td>
<td>4,000</td>
</tr>
<tr>
<td>Cost of food for 1,000,000 trout for one year</td>
<td>1,000</td>
</tr>
<tr>
<td>Total</td>
<td>$47,100</td>
</tr>
</tbody>
</table>

Now for their value. The 1,000,000 of four-year-olds will average a pound each, and are worth at least twenty-five cents per pound in the pond, which makes the four-year-olds worth $250,000

<table>
<thead>
<tr>
<th>One Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000,000 three-year-olds, one-half pound each</td>
<td>175,000</td>
</tr>
<tr>
<td>1,000,000 two-year-olds, one-quarter pound each</td>
<td>87,000</td>
</tr>
<tr>
<td>1,000,000 one-year-olds, one ounce each</td>
<td>30,000</td>
</tr>
<tr>
<td>The worth of all trouble at the end of four years</td>
<td>$542,000</td>
</tr>
<tr>
<td>Deduct the price of growing</td>
<td>47,000</td>
</tr>
<tr>
<td>Profit</td>
<td>$495,000</td>
</tr>
</tbody>
</table>

As these figures stand, they cannot serve as a guide to fish breeders at present, for no one begins to carry on the business on this immense scale. But suppose we divide the figures by fifty, which brings the scale within reach; we then have a profit of $10,000, on an establishment turning out 20,000, four years old, annually. This I believe would be not far from the truth, were it not for one item which Mr.
Ainsworth did not take in, but which closely follows every business like an evil genius, namely, risk.

What this fluctuating item ought to be in the above calculation I will not attempt to say, but I am afraid that at the time the estimate was made it was more than enough to swallow up the profits. It has been growing less and less every year, as trout raising has become better understood, and I believe the time is near at hand when Mr. Ainsworth's figures may be realized on a reduced scale, with not more than fifty per cent deducted from the profits to cover the item of risk.

It may occur to some to inquire what makes the item of risk so large?

I will reply, that it is because the business is new and but little understood; the subject-matter is of a peculiarly hazardous sort, and perhaps, more than all, fish breeders will not take pains to insure the security, which is absolutely necessary to success. These things have made the risk very great, and account for the very significant fact that, in the five years since Mr. Ainsworth's table was published, no one has made a fortune by raising trout for the table, nor to my knowledge derived any very extraordinary income from this source alone. I think, however, the next five years will tell a different story, and I am very much mistaken if some of the trout ponds now under way do not yield within that time some very handsome returns from their marketed trout.

Thus far we have considered the business of trout growing in only one of its branches of profit, viz., raising marketable trout.

There are, as is well known, two other sources of revenue. 

(1.) The sale of spawn. (2.) The sale of young stock.

The first branch can hardly be considered a legitimate branch to base permanent returns on, because the sale of spawn is limited to establishments that are just commencing operations. This trade is a large one now, because so many establishments are starting, but these will some time furnish their own spawn and become sellers instead of buyers, and when the prospective fish breeding operations of the country are under way, there will be a great supply of eggs, with a very disproportionate demand. Indeed, the prospect is that the spawn trade will not be a permanent one of any great value, and therefore cannot be regarded, in its present state at least, as a legitimate ground for basing payment expectations on. It is not so, however, with the trade in young fry and yearlings for stocking other waters.
It is almost a universal custom now, with owners of small gardens, to buy their young cabbages and tomatoes and other vegetables of the large producers, because it is cheaper than to start them themselves. Farmers also buy their pigs instead of breeding them, from the same cause.

Now it is only reasonable to expect the same rule to prevail in fish raising ultimately as it does at present. Many persons who have ponds and streams, and want to keep them stocked, will prefer, and will find it cheaper, to buy their young stock every year, than to work all winter at hatching the eggs.

The trade in young stock, therefore, looks as if it would be permanent, and appears to be a legitimate source from which to expect an income in trout raising. This forms, at present, a very considerable item in the business. Young fry are in great demand in New England, at twenty-five dollars (§25) a thousand, and yearlings at one hundred dollars (§100) a thousand. Many thousands of them could be sold at this day for these, and even at an advance on these, prices, if the fish could be had. The supply last year (1871) did not nearly keep up with the demand in New England. We here find in the sale of young stock quite an addition to the sources of the trout growers' income; and I am informed, by those who are operating near the large cities, that a very considerable revenue could be obtained, at their places, by charging an admission fee to visitors.

There is also money to be made by buying and fattening wild trout for the market, where you can buy them cheap enough. Good, thriving trout, less than four years old, will double their weight in a year, and sometimes much more. Therefore, if you put 1,000 pounds of them in a pond securely protected, they will, in a year, become 2,000 pounds; and the feed, in the mean time, will not cost over §150. That is to say, the increase will cost you not over fifteen cents a pound.

When the various sources of income are taken into account, in connection with the wide margins for profit, it is obvious that successful operations cannot but pay well. I would say, however, in conclusion, that I do not wish to hold out false inducements to persons to go into the business, with the hope of making great fortunes. The item of risk is a very serious one yet, and small operators cannot expect to make more than a fair living. With many it will not pay at all, while it is reserved for only the very successful, and for those who have the few great water facilities of the country, to make the great fortunes.