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April 29th 1872

A TREATISE
ON THE
ARTIFICIAL PROPAGATION

OF
Certain kinds of Fish,

WITH THE
DESCRIPTION AND HABITS OF SUCH KINDS AS ARE THE MOST
SUITABLE FOR PISCICULTURE,

BY THEODATUS GARLICK, M. D.,
Vice President of Cleveland Academy of Natural Science.

GIVING THE AUTHOR'S FIRST EXPERIMENTS CONTAINED IN A PAPER READ
BEFORE THE CLEVELAND ACADEMY OF NATURAL SCIENCE.

ALSO,

DIRECTIONS

FOR THE MOST SUCCESSFUL MODES OF ANGLING FOR SUCH KINDS OF
FISH AS ARE HEREIN DESCRIBED.

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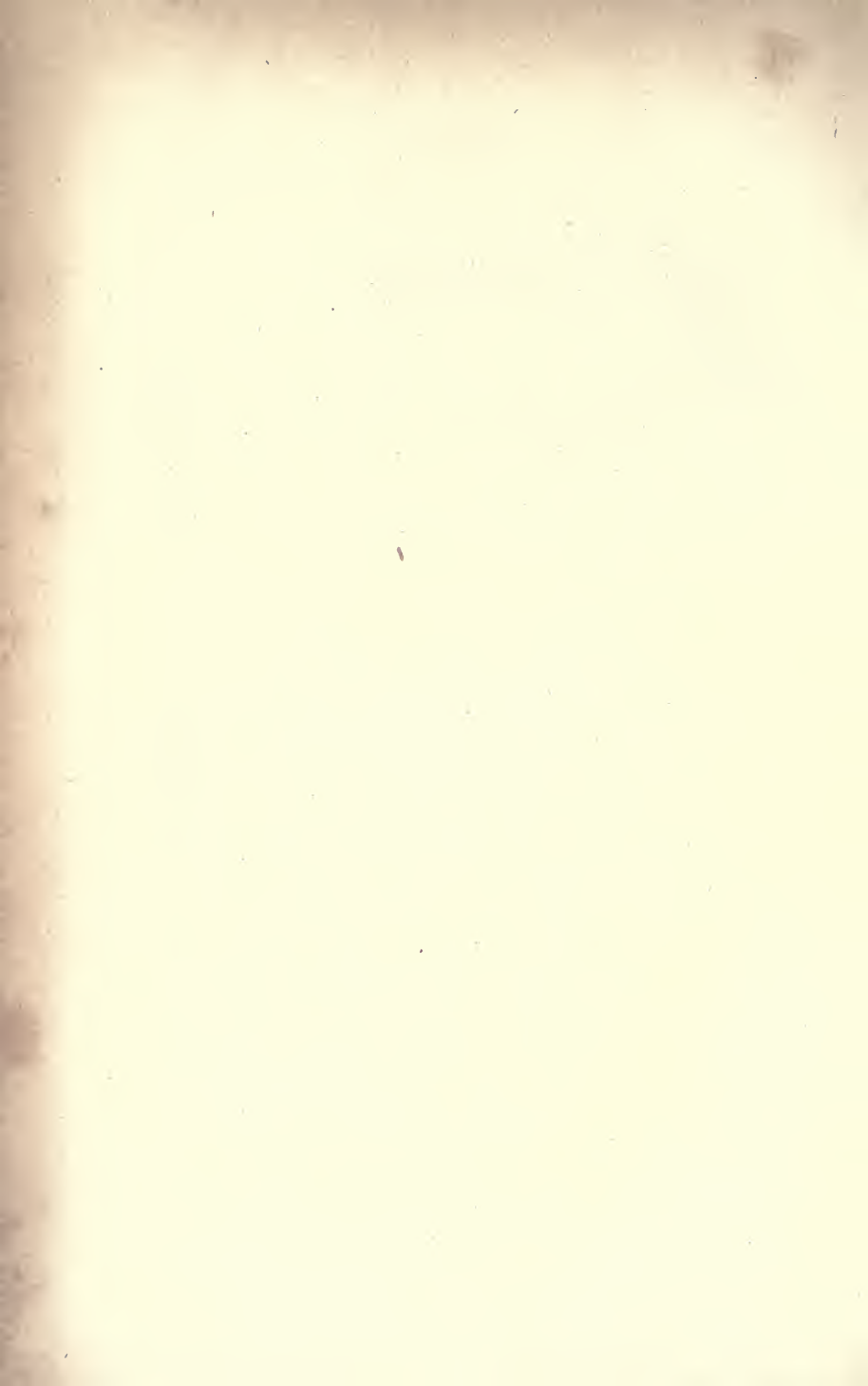
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PREFACE.

I WAS induced to prepare these articles on Fish Culture, for the *Ohio Farmer*, with the ulterior object of publishing them at some future time in a collected form, which I have now done, believing that as yet there has not been any work on this subject, that fully meets the wants of the American public.

That there is a great interest felt in America on the subject, I am satisfied, from the fact that I have received numerous letters of inquiry from persons residing in almost every State in the Union.

I have read with great satisfaction, a work edited and translated by William H. Fry. The work is valuable for the reason that it gives a detailed history of the progress that Fish Culture has made in Europe; besides much information that is valuable in a practical point of view. I am of the opinion, however, that whoever reads it, will agree with me, that it is deficient in some important points, and is adapted, rather to a European than to an American public. One objection, and in my opinion a very material one, is, that with the exception of the *Salmo Salar*, the habits of not a single American fish are given.

I do not wish however to be understood, that the objections mentioned, render the work valueless, but, on the contrary, that it really possesses great merit, and I most cheerfully recommend it to every one who feels an interest in this department of human knowledge.

I shall endeavor in this volume to present the reader, with not only a complete description of such American fishes, as are best suited by their qualities and habits for artificial propagation and culture, but the best methods of propagating and rearing them; together with the most appropriate kinds of water, for each kind described.

The writer hopes to aid in awakening a sufficient degree of interest, to induce our Legislative bodies to enact such laws, as will at least protect those who are desirous of engaging in this interesting branch of industry.

INTRODUCTION.

READ BEFORE THE CLEVELAND ACADEMY OF NATURAL SCIENCE,
FEBRUARY 17TH, 1854,

BY THEODATUS GARLICK, M. D.

THE successful experiments of Messrs. Remy and Gehin, of France, in the artificial re-production of certain kinds of fish, will without doubt, be repeatedly made in this and other countries, and with the same satisfactory results.

The immense advantages resulting from this discovery, particularly, in countries abounding with such a variety and extent of inland waters as our own, can hardly be estimated.

Early in the spring of last year, Prof. H. A. Ackley and myself determined to make the experiment of artificially breeding fish. After some deliberation, we determined to select the speckled trout, (*Salmo fontinalis*) for our first experiment. Accordingly, in the month of August last, I started for the Sault Ste. Marie, with the purpose of obtaining the parent fish, while Prof. Ackley was preparing a suitable

place for their reception, by building a dam across a very fine, large spring of water on his farm, some two miles from this city.

There was no difficulty in capturing as many as I desired, but it was quite another kind of sport to transport them alive a distance of near six hundred miles. After various vexations, among which was the loss of the first shipment, we succeeded in getting down three lots, in all about one hundred and fifty in fine condition, and lodged them safely in their new home, where they seemed as happy and as sportive as they were in the beautiful blue waters of Lake Superior.

In the month of September I made a trip to Port Stanley, Canada, for another lot, and succeeded in getting home about forty more specimens, constituting certainly a very fair beginning to our enterprise.

We did not, however, expect to rear any young fish this season, for we supposed the vicissitudes they were subjected to, such as their transportation, etc., would prevent them from depositing their eggs, but in this we were most agreeably disappointed, for on the 15th of November we discovered unmistakable evidences that they were about to engage in this interesting process.

Several male trout had proceeded up the stream, and commenced preparing the beds in which the eggs were to be deposited. This was done by removing all the sediment and sand from certain gravelly locations. These beds were about one foot in diameter, consisting of coarse and fine pebbles, the spaces or interstices between which were to be the future depository for the eggs. This peculiar construction of their beds, or nests, is highly essential to their preservation, as it protects them from being washed away by freshets, also from being devoured by small fish which are always prowling about seeking them for food.

The male trout at this time was very beautiful, being decked out in the most gaudy colors, imaginable, and his actions showed clearly enough that he was quite vain of his personal appearance.

In the course of five days, the females made their appearance. They were not near so gaudy in their dress, but had a most staid and matronly look.

The next step was choosing their mates. After the usual amount of flattering attentions to the females, with which they seemed highly delighted, and some battles among the males, this important matter was apparently settled to

the satisfaction of all parties. By what principles they were governed in making their selections I was unable to determine, but presume in this respect they are like men, governed more by fancy than judgment.

Our trout were from four to six weeks later than their usual time in depositing their eggs, owing, no doubt, to the vicissitudes incident to transportation, change of water, etc.

On the 20th November they had fairly commenced operations, one pair of fish occupying each bed: the male manifesting the utmost jealousy, and if any suspicious interloper approached, he was instantaneously attacked and driven off. On the 21st, I captured a pair by means of a landing net, and placed them in a bucket of water, and being provided with an earthen vessel, I made my first attempt at artificially spawning and impregnating the eggs. This was accomplished as follows:

I partially filled the earthen vessel with water, and taking the female in my left hand, and making gentle pressure on her abdomen with my right, the eggs were forced into the earthen vessel containing the water; the male was treated in precisely the same manner, forcing the spermatic fluid into the same vessel; the appearance of the eggs was almost in-

stantly changed from their bright golden orange color, to a pale transparent yellow; they were then placed in running water with the vessel containing them.

On the 9th of January one of the eggs was placed under one of Dr. Goadby's microscopes. (The Dr. was at the time giving a course of lectures in this city.) Its appearance delighted the company of scientific gentlemen present, as well as myself. The egg was filled with a countless number of cells, of different sizes, with traces of blood vessels; the eyes also being perceptible.

On the 22d of January we examined them again, and to our joy, we found a young fish, which had just left its narrow place of confinement, to try its new mode of existence; it was very lively in its motions, but could not be considered an expert swimmer, owing to an appendage to its abdomen, of nearly the size of the egg, which in fact it was, and contained the material for the further development of the yet very imperfect fish; this sack was filled with a multitude of minute cells, whose absorption keeps pace with the development of the fish. When the young fish leaves its egg, it measures about half an inch in length. The heart, with the principal blood vessels, and even

the corpuscles of blood, are beautifully shown with a microscope of moderate power. Their external appearance is remarkable. The eyes are large and quite well developed; the pectoral fins are also in an advanced stage of development, and in constant and rapid motion, which I think, in the more advanced stage of the fish, has something to do with its respiration, as they are placed near the opening of the gill covers. The other portions of the fish are quite rudimentary, no other fins being perceptible, but in their place there is an attenuated margin, or finlike substance, as on the tail of the tadpole, commencing where the dorsal fin should be, and continuing uninterruptedly around the caudal, and terminating with the anal fin, or rather where it should be.

This finlike substance undergoes a constant change as the fish grows older. At fourteen days the dorsal, adipose, caudal and anal fins are plainly seen, but as yet none of them have rays, except the caudal, in which they are very distinct. The rays of the caudal fin are first apparent at the center, although the general form of the rudimentary tail is very unsymmetrical, the superior lobe being the larger, and the outline not unlike that of the tails of many heterocercal fishes. At this age the fish has

more than doubled its former length, the mouth, gills and abdominal viscera are visible, and it manifests a desire to take food, by nibbling at the unhatched eggs, and pieces of meat placed in the vessel containing them. Its color is now materially changed, being of darkish gray on its back and upper portions of its side. The sack suspended from the abdomen at this time becomes smaller, and less globular in form, being more contracted anteriorly than posteriorly. The habits of the little creature are also much changed, as it now swims smartly, and endeavors to hide itself when disturbed.

Owing to imperfections in our arrangements where we placed the eggs for hatching, accumulations of sediment buried them up, destroying them by hundreds; this accumulation was much more fatal when the embryo fish was nearly ready to make its exit from the egg. To avoid their further destruction, on the 26th of January we brought the remaining eggs to our office, and placed them in a glass jar, and supplied them, and the young fish, daily with fresh water. In this situation they have remained until the present time, the young fish making their appearance from day to day, the last one rupturing its oval envelope on the 10th day of February. I have seen as many as six make their

appearance in as many minutes. The temperature of the water at the spring was 42° Fahrenheit. Since they were brought to the office the water in which they have been kept, has varied from 42° to 50° .

This experiment has afforded us one of the finest opportunities to be desired for the study of embryology, but professional duties have prevented us from making as minute observation as we could have wished. We have, however, repeatedly and distinctly seen the blood corpuscles in the returning veins enter the auricle of the heart and then pass into the ventricle, and from thence into the aorta. Altogether, it has afforded us one of the most pleasing and instructive lessons in the early stages of animal existence that we have ever had, and I hope that some person of more accurate powers of observation, and having more leisure, will avail himself of these facilities which are within the reach of every man, and give to the world a more extended statement of facts than I have been able to do.

Another fact, in which all are interested, has been clearly demonstrated. Any one who may be so fortunate as to possess a spring of water of moderate size can rear this charming fish in great numbers, and the streams that have been

depopulated by the untiring zeal of the angler, can be replenished with little trouble and at a small expense. Such streams as are not suited to the trout can be stocked with other choice varieties of fish with the same ease.

The number of eggs produced by a single female trout in one season has been variously stated by different writers, but it is a moderate statement to say that it is many hundreds.

A word to those who wish to make the experiment, and I have done. The attempt should only be made when the eggs are mature; to be secure in this, it will be best for the beginner to take the parent fish when they are engaged in depositing the eggs. After the eggs are forced into the vessel containing the water, they should be stirred about a little, the water poured off, and the vessel filled again before the spermatic fluid is added, after which the water should be a second time agitated, in order that it may come in contact with all the eggs; this is necessary to the impregnation of all of them. They should then be placed where they can have running water passing constantly over them. This may be done by having a series of boxes partly filled with coarse sand and gravel, each placed below the other in the form of a stairway, the water passing

from the first box to the second and so on. It would also be well to have the bottoms of the boxes pierced with small holes in order to prevent the sediment from accumulating, which is very destructive to the eggs.

These general rules, if followed, will be sure to crown the effort with success.

CHAPTER I.

ARTIFICIAL PROPAGATION OF CERTAIN KINDS OF FISH.

SHORTLY after the discoveries of Messrs. Remy & Gehen had been communicated to the French Academy of Sciences at Paris, by Dr. Haxo, the French Government, viewing the discoveries in a favorable light, appropriated thirty thousand francs, (\$6,000,) and appointed a committee consisting of two persons, namely Messrs. Berthot & Detzem—engineers of the Rhine and Rhone canal—to erect a Government establishment for the artificial culture of fish at Huningen. The establishment did not go into operation until 1852, some three years after the discovery.

The establishment, during the first six months of its operation, produced by artificial fecundation over a million and a half of living fish, of which about six hundred thousand were trout and salmon.

With these facts before us, it should not be surprising that the subject is attracting the attention of some of the best minds in our own country; more especially when we consider the impoverished condition of our rivers and streams, many of which are susceptible of being inhabited by innumerable salmon and trout, and since a replenishment is now no longer problematical.

The following directions, if strictly adhered to, will be crowned with success in the hands of any one:

The eggs of fish are not sufficiently matured to be successfully impregnated until the fish is engaged in depositing the eggs; therefore no attempt should be made to extrude the eggs artificially until the fish has been seen or known to deposit them; but they should be extruded as soon as possible after the fish has commenced depositing them, for the reason that more eggs can be secured.

The parent fish should be taken with nets while on their spawning beds; the size of the nets will, as a matter of course, depend upon the size of the stream, or other waters, where the fish are engaged in spawning—for small trout streams the common landing net of the angler is sufficiently large.

After one or more pairs of fish are thus taken, they should be placed in a tub or bucket of water; the female is then to be held in the left hand, and a gentle pressure made with the right hand upon her abdomen. At the time of the pressure, the right hand should be carried downward; if the eggs are mature, they will flow from the fish with a very slight pressure, and are to be received in an earthen vessel partly filled with clean water; then treat the male fish in precisely the same manner. The

spermatic fluid from the male being received into the vessel containing the water and eggs, the eggs should then be stirred about very freely in the water, and suffered to remain ten or fifteen minutes, when the water should again be changed, and after a short time this change should again be repeated. It is thought by some persons, that the eggs should be stirred or rinsed, and the water changed before the spermatic fluid is added. The precaution, I think is a good one, as it serves to remove any mucus, with which the eggs are more or less, covered, and which to some extent may prevent a perfect contact of the sperm with them.

A very small portion of the spermatic fluid is sufficient to impregnate the eggs of one female; in fact, the sperm of one male is sufficient to impregnate the eggs of half a dozen females.

I have recently read an extract from a foreign journal, which stated that Dr. Robertson, of Dunkeld, (Scotland, I suppose,) denies that the eggs are impregnated after they are extruded from the female, but contends that they are impregnated previous to their development within the body of the fish. If actual observation or experiment confirms this statement, there will be no necessity of obtaining the sperm or milt of the male fish, which at present is considered indispensable. I cannot give my assent to this statement, for the

following reason, namely: If the ova, or eggs, are impregnated previous to their development, why is it that the spermatic fluid is so abundant in the male just at the time of spawning, and not at any other? At any other period than that of spawning, this secretion is so limited that it can be extracted only with great difficulty, even by very hard pressure. In a series of experiments with trout conducted last fall, by myself, I failed to impregnate well developed eggs, which I knew were mature, by using a premature male.



The above cut will convey a sufficiently correct idea of the manner of extracting both the eggs, and spermatic fluid from the living fish.

Prof. Ackley claims that the muscalonge actually copulates, and extrudes a limited number of eggs after each copulation. Having never had an opportunity of observing the habits of this fish, while engaged in spawning, I am unable to give an opinion respecting it.

CHAPTER II.

TREATMENT OF THE EGGS AFTER FECUNDATION.

AFTER the eggs, or ova, have been procured, as described in the preceding chapter, they should then at once be removed to a suitable place for incubation. For this purpose, different plans have been adopted, yet all of them are essentially the same.

The plan adopted by Prof. Ackley and myself, and which we find to answer the purpose in every respect, is as follows:

At the head of a spring we built a house, eight feet in width by twelve feet in length. We placed a tank, made of two-inch plank, four feet wide by eight feet long, and two feet deep, in the end of the building nearest the bank. The water from the spring enters the tank through a hole near the top, and escapes through a similar hole at the other end, from whence it is received into a series of ten successive boxes. These boxes are eighteen inches long, eight inches wide, and six inches deep, and are so arranged that the first is much higher in the series than the last one. They must be filled with clean sand and

gravel to the depth of about two inches, the sand being placed at the bottom. The impregnated eggs are to be scattered over and among the gravel, care being taken not to have them in piles or masses.

The boxes should be carefully examined every few days after the eggs have been deposited in them, and all the eggs which have lost their vitality should at once be removed. This may be effected with a pair of forceps made of wire, the jaws of which should be flattened a little, in order to seize the egg with greater facility. The eggs which have lost their vitality may very readily be distinguished from the others by their whiteness.

It is very desirable that pure, clear water should be used, in order to avoid a deposition of sediment, which is very destructive to the eggs, especially toward the close of the term of incubation. When sediment is found to be accumulating, the water should be agitated with a goose-quill, or soft brush, moving the quill or brush briskly about in the water, and then suffer it to run off. Repeat this process until the water is free from sediment, and runs off clear; or, the eggs may be removed into a vessel filled with clean water, with a skimmer, there to remain while the boxes are being cleansed.

The hatching boxes should be grated on that side from which the water escapes, with wire cloth, the meshes of which should be sufficiently fine to prevent the eggs, or the young fish, when they make their appearance, from passing out.

A very neat and convenient hatching apparatus is the flat wicker basket, the interstices of which are fine enough to prevent the eggs from passing through; these baskets are to be placed in running water. Care, however, must be taken, as well as with all other apparatus for the same purpose, that a place be selected where the current of the water is not so rapid as to wash or pile the eggs up in the end opposite to where the water enters. Whenever the baskets become foul, by sediment or vegetable matter, the eggs can be transferred to a clean one, and the basket cleansed.

A conduit, or flume, must be constructed, of plank or boards, to contain a sufficient depth of water, in which the baskets are to be placed. The utmost cleanliness is absolutely necessary, during the whole time of incubation; it is one of the essentials to insure success.

The method adopted by Gehen & Remy was, to place the eggs in zinc boxes, of about one foot diameter, with a lid or cover on them, and the sides of each box were pierced full of small holes, care being taken to have the edges of the holes

very smooth. These boxes were then partly filled with sand and gravel, and placed in running water. They partially buried the boxes in the gravelly bottom of the streams, and there examined them from time to time. Fig. 1 represents one of these boxes.

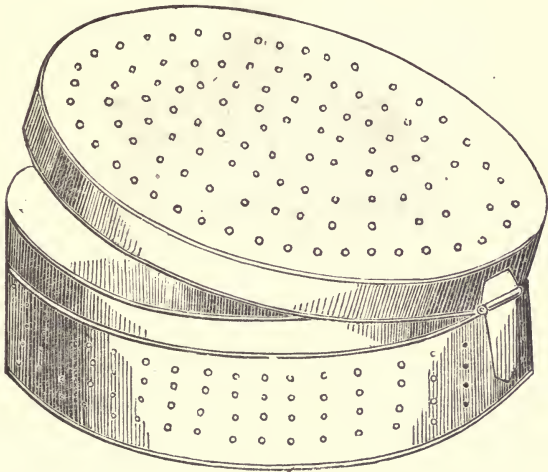
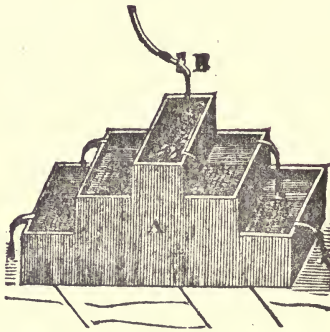


FIG. 1. REMY'S BOX.

The plan adopted by M. Costa, at the College of France is to arrange several parallel boxes, in the form of steps, on each side of the principal one, which is placed at the top of the series, from which all the others are supplied with water, the top one being supplied from a fountain, and the supply of water being regulated by a stop-cock.

In this case, the eggs are placed on willow hurdles, instead of gravel. Fig. 2 represents the hatching apparatus adopted by Mr. Costa.

FIG. 2.



M. COSTA'S HATCHING APPARATUS.

A, parallel boxes, in which are placed the willow hurdles, and upon which latter the eggs are placed. B, stop-cock, from which water is supplied.

Another, and yet more simple plan is shown by Fig. 3. This apparatus may be set up in one's house; the water being supplied to the reservoir B from time to time. A cask, or barrel, or anything which will answer the purpose of a reservoir. The box in which the eggs are placed is represented at A. The waste water flows into a tub or bucket C.

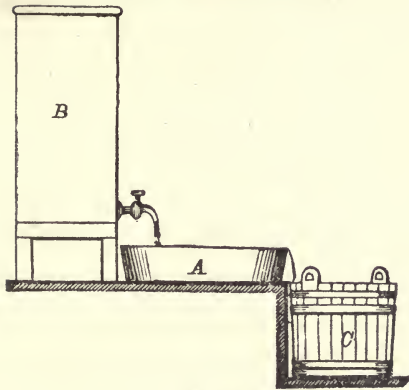


FIG. 3.

Whatever plan may be adopted, great care and watchfulness are essentially necessary to insure success. A vegetable parasite, termed by naturalists *byssus*, frequently attaches itself to the eggs, and destroys them. The best way to remedy this evil is to remove very carefully all the eggs that are free from the parasite, and throw those away which have been attacked, and at the same time thoroughly cleanse the boxes or baskets.

CHAPTER III.

TRANSPORTATION OF THE EGGS.

COLLECTING and transporting fish eggs is at present, and has been for centuries past, a distinct, as well as an important branch of commerce in China.

This branch of industry was specially protected, and on an extensive scale, by the ancient Roman Government. Stocking rivers and lakes with a great variety of fishes was regarded as a measure of public utility.

The practicability of transporting the fecundated eggs of fishes to great distances has been amply proven by experience.

It is true that there are some kinds of fish whose eggs hatch in so brief a period of time that they cannot be kept many days in an unfavorable condition, or one in which the process of incubation would be arrested. The eggs of the pike, for example, hatch in ten to twenty days; but the eggs of all the different species of salmon require such a comparatively great length of time

to complete the process of incubation, that they may be safely conveyed from one end of our country to the other. I had intended to send some eggs of the brook trout (*salmo fontinalis*) to France last fall, and to obtain some European species in exchange; unforeseen obstacles prevented me from so doing, but this year I expect to consummate this exchange.

Various methods have been adopted by different individuals for the transportation of the fish eggs. Gehen & Remy procured tin boxes, pierced with small holes; in these they put first a layer of wet sand, about half an inch deep, then on this sand a layer of pebbles, about the size of playing marbles; in the interstices of these pebbles they placed the eggs; next they put in another tier of pebbles, and again filled the interstices with pebbles, and so on, until the box was filled.

M. Costa, whose experience and observations give great weight to his opinions, objects to this method, for the reason that, in consequence of the perforations, the box becomes dry, and while the box is in transition from one place to another it will necessarily be more or less jolted and jarred, and the weight and motion of the pebbles will crush and destroy the eggs. He advises the following method, which, perhaps, is the best one

known at present, and is the one which I have adopted, namely:

Discard the pebbles altogether, and take clean, fine, wet sand, in boxes devoid of holes. Spread the sand on the bottom of the box; on this sand place a layer of eggs, at the same time being very careful not to permit the eggs to touch each other; then over these eggs spread another layer of sand, and then another layer of eggs, and so on alternately until the box is filled, so that the lid presses on the sand; this will prevent any motion of the contents of the box. The box, with the contents, but the lid removed, should then be dipped in clean water, for the purpose of having the sand thoroughly saturated; after this has been accomplished, the lid may be fastened down.

The boxes should be kept in a low temperature—not so low as the freezing point, however. The boxes which I use are made of tin, and in size are about five inches in length, the same in breadth, and about four inches deep. The boxes used by M. Costa are made of wood, and are somewhat larger than those above described. The boxes should not be much larger than those which I use, for the reason that in larger ones the weight of the sand would injure, if not destroy the eggs.

By this method, the eggs of the salmon family, as well as many other species of fish, may be kept for a month or more. M. Costa kept them in this manner nearly two months.

Before removing them from the boxes, the box should be dipped in clean water, and the sand permitted to become thoroughly saturated, otherwise the eggs might be injured during the process of removal. In some instances, M. Costa found the eggs, upon being removed from the sand, a little shriveled; after being placed in the hatching apparatus, they soon regained their former plumpness, and a very large proportion of them gave birth to healthy young fish.

It is of the utmost importance that the eggs be not packed in sand immediately after their fecundation, but should be permitted to remain quiet in pure water—running water, if possible—for several days; in fact, if they could so remain for two weeks it would be preferable.

M. Costa recommends that the embryo fish should be so far developed that the eyes may be perceived through the membranous covering of the eggs, looking like two little black specks. The reason for this delay in packing the eggs is simply this:

The vitality of the embryo is much more sensitive—more liable to be destroyed at this early

stage of existence than when more developed; beside, when the eyes are perceptible, it is known to a certainty that the eggs are fecundated.

Another method of shipping eggs, (and a very good method it is, too,) is to place the eggs in a box filled with aquatic plants, with a sufficient amount of water to keep the whole wet. This is an excellent method, in cases where the eggs are to be kept but a short period of time.

Yet another method is recommended, which is, to place the eggs between the folds of clean, wet cloth—thick blanketing is recommended—placed in boxes in the same manner as the sand in M. Costa's method—that is, in alternate layers—the whole to be thoroughly saturated with the water.

The French Government, at the present time, supplies, from its establishment at Huningen, eggs of the most select varieties to every department of France, so that in a very short period of time the rivers, lakes, and even the bays of France will be teeming with shoals of fish, where they had become very scarce, and in many places, in fact, were none at all.

CHAPTER IV.

TRANSPORTATION OF FISH.

It sometimes so happens that it is desirable to transport live fish from one location to another. The transportation of live fish has always been a laborious business to me, and hazardous to the fish, until I hit upon the plan of conveying them in water, made very cold by the addition of ice. I carried four hundred and twenty trout a distance of twenty-eight miles without changing the water once, in a barrel only three-fourths full of water; the water was kept as cold as it possibly could be by frequent additions of ice. I lost only four or five of the fish, and these were killed by being jammed between the pieces of ice. They were in the barrel fully eighteen hours without the water having been once changed.

I feel very confident that they would not have lived a single hour in the water, had it not been for the extreme cold caused by the frequent additions of ice. The fish, however, were all small— one-third of them, perhaps, were two years old; the remainder were yearlings and young fry of six months.

Very young fish can be transported much more safely and with less care than older ones, but I am unable to say whether they can endure as great a degree of cold as older ones. I have never made the experiment, but suppose the cold would not prove injurious to even newly hatched fish.

Another reason why young fish are much more easily transported than older ones is, that they do not exhaust the water so rapidly; but as eggs are so much more easily conveyed from place to place than the living fish, I would recommend to all persons who wish to stock streams or ponds, to procure the eggs by all means, as it is far more convenient and less hazardous to transport them than the living fish.

I have kept in my house, in a glass jar, the capacity of which does not exceed two quarts, a great number of newly hatched trout for weeks, by changing the water no oftener than once a day; and as far as I could discover, they did just as well as though they had been put in running water.

M. Costa has frequently kept young salmon and trout in glass jars for a long time without changing water, by putting aquatic plants into the jar immediately after the fish are hatched.

CHAPTER V.

REPORT ON ARTIFICIAL FISH-CULTURE,

And on Stocking Barren and Impoverished Rivers with Fish artificially hatched. Made to the Minister of Commerce by M. MILNE EDWARDS, Member of the Institute.

IN 1850 the attention of the French Government was called to the discovery of Messrs. Gehin and Remy, and the Minister of Agriculture and Commerce appointed a member of the Academy, a distinguished *savant*, M. Milne-Edwards, to examine the subject carefully and make a report.

The following is his report;

Sir:—Owing to the interest which you feel in all discoveries calculated to increase the alimentary resources of the country, you desired to form a correct opinion of the attempts which for some time have been made, whether in France or in England, to ensure the multiplication of fish in ponds and rivers, and to augment the value of products of fisheries.

You have done me the honor to submit this question to my examination, and have charged me most particularly to render a complete account of the results obtained by two fishermen, who followed

their trade near the sources of the Moselle, and who, by a process of artificial fecundation, have established in the département of the Vosges, a veritable *fish factory*. With pleasure I conformed to your wishes, and I will be well pleased, Mr. Minister, if the investigations I have made, can aid you in endowing our rural industry with a new source of wealth, the importance of which will not be undervalued by physiologists or agriculturists. Fish is an article of food rich in nutritive qualities, and to augment its abundance, either on our coasts or in our streams, will be a real benefit for all classes of population. River fishing is generally little productive in France; but it is only necessary to cast one's eyes upon the doings of our neighbors of other countries, to comprehend what might be its value, if means be found to stock with good fish our rivers and ponds, as amply as nature has stocked those of Scotland and Ireland, and as agriculturists stock their fields with herbiverous animals equally destined to serve our subsistence.

River-fishing has long been the objects of enactments favoring the reproduction of fish, and protecting the development of the fry. The royal ordinance of 1669 forms the basis of our legislation on the subject, and contains many clauses of incontestible utility.

Proprietors of ponds bestow ordinarily some care upon stocking them, but all that relates to reproduction of fish in our rivers is left to mere chance, and while bitterly lamenting the constant and rapid decrease of their products, we have not, till now, given sufficient consideration to the remedies for the evil.

Public attention was at last awakened to this question by a lecture delivered two years since, at the Academy of Science by one of our most distinguished zoologists, M. de Quatrefages, formerly one of the Faculty of Science of Toulouse. This learned and elegant writer, gave our agriculturists useful counsel on the art of bringing up fish, and strongly urged upon them the putting in practice of a process of multiplying their numbers, long well known to physiologists, and often experimentally employed in their cabinets, viz: that of artificially fecundating the eggs. We know by the labors of Spallanzani, and by the experimental researches with which you, yourself, Mr. Minister, and your ancient colleague, Prevost, (of Geneva,) twenty-five years enriched science, that all fecundation is the result of the action exercised upon the egg at its state of maturity by the living spermatozoa with which the semen or milt is charged, that this action takes place through the direct contact of those two repro-

ductive elements, and that the physiological puissance of these same agents may be preserved during a longer or shorter period after they have been taken from the living bodies which have given them existence.

With a great number of inferior animals, the parents part in the work of reproduction, consists only in the formation and emission of these two generic elements; the egg is not impregnated till after being spawned, it meets the spermatozoa, the contact with which, necessary to endow it with life, only takes place by the concurrence of exterior causes, independent of the action of the parents, for example, by the course of the current in which the milt is deposited. The experimentalist can, therefore, determine at will this physiological phenomenon, by mechanically mixing the eggs and milt of these animals, and the same result will be obtained by this process as by the natural one.

The observation of zoologists show, too, that in the general harmony of nature, the fecundity of animals is regulated not only with regard to the causes of destruction to which the young are exposed before they become capable of reproducing their species, but also in view of the chances of non-fecundation to which the eggs are submitted as the contact of the eggs with the seminal fluid

takes place, after they have been spawned, and depends more or less upon chance. Fish belong, for the most part, to the category of animals among which there is no act of copulation for reproduction, that being effected simply by the ejection by the male of the milt, or semen upon the eggs which have been spawned by the female.

To procure the development of the embryo, therefore, in the otherwise sterile eggs, the naturalist, in the experiments of his laboratory, has only to imitate that which happens normally in nature; that is to say, to bring them in contact with water charged with milt; impregnation, then, is soon effected; and to procure this milt, as well as the eggs to be impregnated, all that is required is a light pressure of the abdomen of the males and females, whose products are matured and whose lives will not be endangered by the operation; or these products may even be procured by opening the bodies of the newly dead subjects, for the eggs and the milt preserve their vitality for some time after the death of the bodies containing them, and thus from two corpses may be brought forth a numerous and strong generation.

This fact was fully established by Count de Goldstein, about the middle of the last century long before Spallanzani published his beautiful researches upon generation. In 1758 this judi-

cious observer addressed to an ancestor of the celebrated Fourcroy, a most interesting memoir upon artificial fecundation of trouts' eggs, and upon the application to stocking rivers, of which the discovery was susceptible.

An extract from Goldstein's work, was inserted in a work called *Soirees Helvetiennes*, and some years later, in 1770, Duhamel du Monceau gave a translation of it in the third volume of his *Traite general des Peches*, published under the sanction of the Academy of Sciences.

About the same period, a German naturalist, Jacobi, published at Hamburg an equally interesting letter upon the art of bringing up salmon and trout, and on the production of these fish by means of artificial fecundation. At a later date analagous experiments were made in Scotland by Dr. Knox, Mr. Shaw and Mr. Andrew Young. In 1835, Signor Rusconi, so well known among naturalists by his work on the embryology of salamanders, published in the seventy-ninth volume of the *Bibliotheca Italiana*, new observations on the development of fish, and gives equally instructive details in artificial fecundation of the eggs of the tench and the ablette. At my suggestion, the translation of this memoir was inserted in the *Annales des Sciences Naturelles pour 1836*.

I would add, too, that it was by recourse to

this method of multiplication that Messrs. Agassiz and Voght procured all the embryos necessary for their studies on the development of the palee, a species of salmon of the Swiss lakes the anatomical history of which these two naturalists published in 1842. The philosophical fact, then, upon which M. de Quatrefages relied to stimulate agriculturists to the *manufacturing* of fish, in the same way they produce grain or meats, offered nothing new to zoologists, and to their remembrance M. de Quatrefages was the first to recall the claim of Goldstein as the discoverer of artificial fecundation. But under our system of education, truths well known by naturalists are unknown by most other men, even the best informed, and it was not unnecessary to call public attention forcibly to this application of science to rural industry, which not only had not profited by the results of the discovery, but I think I can safely affirm that there were then not ten agricultural authors or teachers in all France, who had the least idea of the service which physiologists had so long before rendered them.

Under such circumstances we should not be astonished to find in one of the most secluded valleys of the chain of Vosges, two illiterate fishermen, but endowed by nature with a rare spirit of observation and a rarer perseverance,

being ignorant of prior discoveries, and wishing to find some remedy for the decrease and threatened extinction of their trade, employing several years of their time in laboriously making over again the same experiments already made by the physiologist I have cited, and in rediscovering what naturalists had been acquainted with for a century.

But if these poor peasants of Bresse were preceded in their researches by scientific men, and if they have not enriched natural history with fresh discoveries, their labors are no less worthy of interest, and they have a claim upon our consideration, for they seem to have been the first among us to make practical application of the discovery of artificial fecundation to the rearing of the fish, and have thus the merit of creating in France a new branch of industry.

The first essays of Messrs. Gehin and Remy were made in 1842. Having by a long course of observation become acquainted with the mode of reproduction practised by trout, and being assured of the possibility of artificially fecundating its eggs, they applied themselves to the production of quantities of these fish to stock the streams of the canton. Success crowned their efforts, and notwithstanding their feeble resources, and the difficulties of all sorts they had to en-

counter, they still obtained considerable results.

They were enabled to stock, with young trout artificially hatched, two ponds near their village of Bresse, one of which furnished last year 1200 trout of two years old.

Gehin and Remy estimate at about 50,000 the number of young fish they have put in the Moselotte, a little river of Bresse, which empties into the Moselle, near Remiremont; they have put in practice their mode of stocking in several other localities of the same center, as appears by documents furnished by the authorities of Saulxres, of Cornimont, and of Gerardmer. Besides these, M. Kienzi, mayor of Waldenstein, in the department of Haut Rhin, deputed them to restock the water courses of his commune, and this intelligent official gives assurance that they perfectly succeeded.

I would add also, that, wishing to render the discovery of the widest public utility, our fishermen never made any secret of their processes, but, on the contrary, readily initiated any one who desired to undertake similar work. All who have ever had occasion to witness the labors of Gehin and Remy, bestow on them the highest praise.

I visited their establishment and witnessed some of their experiments. The Society of Emu-

lation took up and fully investigated the subject, and bestowed on each of these worthy men an honorary medal. The work they proposed it seems to me they fully succeeded in, and to render their country great service they only need the means to extend their operations. I do not judge solely by the results obtained by Gehin and Remy, but also by similar ones on a large scale, which I found to have been obtained for several years past in Great Britain, and which had excited there considerable interest.

In fact, M. Boccius, a civil engineer of Hammersmith, has practised artificial fecundation in stocking several rivers in Great Britain, and seems to have had complete success.

In 1841 he worked in the streams belonging to Mr. Drummond, in the neighborhood of Uxbridge, and he estimates at 120,000 the number of trout he there brought up. The following years he put in practice the same processes on the magnificent domain of the Duke of Devonshire, at Chotsworth; then for Mr. Gurnie, at Carsolton; and Mr. Hilbert, of Chatford; finally, the Anglers' Club put under his charge the important fishing grounds of Ansva-Magna, in the county of Hertford, and M. Boccius assured me that he had already artificially hatched there at least 2,000,000 trout. He has published a

book upon his method of stocking streams, and it seems that a society is about to be formed under the patronage of Sir H. Labouchere, with a view of attempting to stock the Thames with salmon.

The process employed by Gehin and Remy is simple and easily practised; it hardly differs from that adopted by Boccus, and equally resembles the method described by Jacobi, nearly a century ago.

Trout-breeding takes place in December, and in order to have eggs for artificial hatching, it suffices to press lightly, before and behind, the abdomen of a female fish ready to hatch; and her eggs, in falling, should be caught in a vessel with water, and afterwards sprinkled with milt obtained in the same manner and diluted.

If the eggs have not arrived at their term when operations are commenced, they will only be run out with a strong pressure, and in such case the fish should be left in a preserve during some days before this forced birth is adopted, for neither the eggs nor the milt can be usefully employed in a state of immaturity, and the life of the parent fish would be endangered by rough handling.

On coming in contact with the spermatised water, the eggs change color—before fecundation

they are transparent and yellow—so fecundated they become whitish or rather opaline. A trout, aged some two years, and weighing about 125 grammes, can furnish about 600 eggs; a trout of three years, 700 to 800; and it is also to be noticed that the milt of one male is enough to fecundate the eggs of half a dozen females, or even more.

Messrs. Gehin and Remy placed the eggs so fecundated in a tin box pierced with holes on a gravel bed: these boxes are about fifteen centimetres in diameter, and eight deep, and can contain each a thousand eggs.

They are then to be placed in some streamlet of which the waters are pure and lively but not deep: in this they are partially buried, and so disposed that the water in the boxes is rapidly renewed, for the agitation of it is necessary to insure the respiration of the embryos, and also to hinder the development of confervas, which will not be slow to catch and destroy the eggs if the water be stagnant. The development of these embryos lasts four months, and it is generally towards the end of March or in April that the hatching takes place; during six weeks more the new-born trout carry under the abdomen the umbilical vesicle which holds the remains of the nutritive matter, analagous to the

yelk of a bird's egg, and at first, by means of this substance the minnows are nourished; but when absorption takes place, the young fish have need of other nutriment, and should then be driven out of the box in which they are cradled, and permitted to swim freely in the streamlet which they are to stock.

In fine, to procure for these little fish suitable and abundant nourishment, it is only necessary to leave or put in the water some frogs, whose spawn they will greedily eat, while the tadpoles afford excellent food for the older trout. When the young trout so brought up are destined to stock a river, they should be placed in streams tributary to it, and water selected which rushes over pebbles or rocks.

In proportion as these fish grow, they descend spontaneously to the deep water, whither they arrive only when they are sufficiently agile to protect themselves against the enemies which they may encounter; while if they are at once placed in the midst of other voracious fish, they will have but a small chance of escaping death. When they are so raised in streamlets or ponds, precaution must be taken to separate the product of each year from the former one, as the big trout will otherwise eat up the little ones; and to avoid this the young fish in the same circle should be of one age.

To establish after a regular fashion this branch of production, there should be at least three streamlets or brooks, for the fish to be changed during three years, new ones being placed in them as fast as exhausted.

Unhappily Messrs. Gehin and Remy have not at their disposal the necessary funds to complete this work. They have obtained the grant of a fish-pond for this purpose, and bought another for 800 francs; but now their pecuniary means are gone, and if sir, under your kind protection, they do not get some help from Government, I fear it will be impossible for them to pursue the trials so satisfactorily commenced.

The labors of Messrs. Gehin & Remy appear to me the more worthy of encouragement, as success can afford but little profit to such devoted and active men, but will contribute to increase the alimentary resources commanded by people on the banks of streams. Only in considering fisheries as works of public utility, and causing them to be executed by the State, can we hope to give real importance to our river fisheries; but in applying a small sum to this end, we will arrive, I have no doubt, at important results for the country.

If the fish-breeding practiced by Messrs. Gehin & Remy were only applicable to trout and to

other fish of limited supply, I would not attach as much interest to it as I do; but it may be applied to salmon, and I am convinced that it would be easy thus to restore to the rivers of Brittany ichthyological riches which are now disappearing, and even to acclimate salmon in rivers which, up to this time, have not been frequented by that fish.

Nothing is easier than to transport eggs just laid, or living salmon of which the abdomen is filled either with eggs or milt; and even when these die on the road, the hatching of their eggs can be attained. In placing the eggs so acquired in streamlets properly chosen, the young salmon will grow as though spawned there by their parents; they will emigrate as usual to the ocean, and in its depths they in turn will spawn, and will not fail to return in great numbers to the stream whence they proceeded, and in following its course seek a proper place for the growth of their progeny.

We know, in fact by experiments already old, made in Brittany by Delandes, and by observations of the same kind, repeated in our day in Scotland by the Duke of Athol, Sir W. Jardine, Mr. Baigrie, Mr. Hayshan and Mr. Young, the Director of the fisheries of the Duke of Sutherland, that guided by a singular instinct comparable

to migratory swallows, the salmon after having emigrated far into the sea, returns ordinarily to the water where it was spawned, and the individuals of the same species are so perpetuated in certain rivers without mixing with those of strange waters.

It seems to me consequently indubitable, that in the space of a few years it would not only be possible greatly to multiply salmon in all the waters natural to them, but to introduce and acclimate this large and valuable fish in many of our streams hitherto without them. For the salmon and the trout also, as well as for many other kinds, the method of Gehin and Remy appears to be the surest method of stocking rivers; but we cannot have recourse to the artificial fecundation of eggs to stock fresh waters of certain kinds, of which the introduction, however, would be of great utility in certain localities. Thus, eels are never caught at maturity with milt or eggs, and these fish seem to be only produced in the depths of the sea, whence just spawned they go in legions innumerable every year to occupy rivers, where they are known by our fishermen under the name of *montee*.

To supply brooks and streams needing them, such spawn must be transported, and the operation renewed periodically; and M. Costa has

shown that this transportation can be easily effected, even to considerable distances.

For this purpose it is sufficient to place the young eels in grass kept wet. The experiments which M. Costa is now pursuing at Paris in the laboratory of the College of France, proves that young eels can be fed at small expense, so that they will grow rapidly, and it seems to me that in many marshy places, raising eels would be profitable.

If I had to treat here of marine fishing, I would ask of you, sir, permission to call your attention to several matters touching the treatment of our oyster beds, and the means of favoring the multiplication of these mollusks. A manufacturer of charente. M. Carbonnel, has conversed with the Academy of Sciences several times laterly, and thinks it would be easy to establish on our coast at different points such artificial oyster beds. M. de Quatrefages has also requested the naturalists on coasts to try the artificial fecundation of oysters, and I am persuaded that in studying experimentally all that relates to the generation of these mollusks, we shall arrive at results extremely interesting for industry as well as science. But in the actual state of our knowledge relative to the physiology of these animals, we cannot pronounce on the

value of the mode of multiplication which the authors I have just cited propose to employ.

Whatever it be, after the entire results of which I render you an account, and after experiments analagous to those of Messrs. Gehin and Remy, made by M. Lefebvre, of Vaugorard, it seems clear that with perseverance, we can, with little expense, ameliorate the ichthyological breed of France, and also for our territory covered with water, a revenue much more considerable than that now derived.

This would be for the whole country an increase of riches, and trials of this kind appear to me all the more important, as several circumstances tend to diminish the alimentary resource of our rivers. The increasing variety of fish in a good number of our rivers does not arise solely from the manner in which fishing has been pursued, but from other causes, among which is the extension of manufacturing industry. Thus, the toll gates established in such numbers for the service of hydraulic motors, are so many obstacles to the production of various fish, which require to ascend the rivers to their head waters to find fit spawning spots, and single propogators arriving in small numbers in the streamlets, the fish interests of the river suffer, for the eggs are not in a condition favorable to the develop-

ment of the young, and the means of recruiting the entire species is rapidly lessened. If, as in Scotland, and even in England, there existed in France many rich proprietors who possessed water courses of considerable extent, we could leave to the care of private individuals all matters relating to improved river fishing, for to whomever one of these streams belonged, he would be interested in increasing its products. But with us it is altogether otherwise, and the individual who would occupy himself with stocking a stream with fish, could hardly hope to reap personal profit therefrom; he would augment the alimentary resource of his fellow citizens, and thus render his country solid service, but he alone would enjoy but a small interest in the benefit so diffused, and ordinarily would want the stimulus, to undertake the labor.

The stocking of rivers, then, should be considered a matter of public utility, and it seems to me that it is the business of the State to look after it.

Trials of this kind made on a grand scale, and prudently conducted, and confided to intelligent men, would not involve heavy expenses to lead to important results. If you judge proper to have them executed, you will find in the two fishermen in question, capable agents, and I would

add that the charge of such work would be the least recompense the government could make them.

For the rest such an enterprise would necessitate serious preliminary studies, and give rise to several questions, for whose solution the opinion of the administration of waters and forests would be necessary, as well as the light of naturalists, and it would perhaps be necessary to have a mixed commission. To sum up—we perceive that the stocking of fresh waters with artificial methods was long since thought of, but it was only tried in France lately: that Messrs. Gehin & Remy appear to have been the first to put the method in practice among us, and that for their part they have arrived at results analagous to those obtained at the same period in England by Mr. Boccius: that the labors of these two fishermen are worthy of attention, and that in applying to the reproduction of salmon the means they have successfully used to rear trout, we shall be enabled largely to increase the interests of our river fisheries.

I have the honor, &c.

MILNE-EDWARDS.

CHAPTER VI.

IN addition to the Report of M. Milne-Edwards, we present to the reader the Report of M. Costa, a gentleman of rare attainments, and filling a Professorship in the College of France with distinguished ability. These two documents ought to go far in removing any doubts in the minds of those who are prone to scepticism on the subject of fish-culture.

REPORT

On the means of Stocking all the Streams of France with Fish, addressed to the Minister of the Interior of Agriculture and Commerce.

PARIS, JULY 12, 1852.

SIR:—In your letter of the 30th of June, you asked me to visit the fish-breeding establishment at Mulhouse, of Messrs. Berthol and Detzem, engineers of the Rhone and Rhine canal, and to suggest to you measures so that their works can be made to stock all the streams of France. Accordingly I now put you in possession of the result of this mission.

The discovery of artificial fish-breeding was long hidden in the laboratories of science, where

it remained confined to physiological experiment; but lately it has been practically set forth by the Count de Goldstein, by Boccius, and above all by the two fishermen of Bresse, and sober inquiry and trial have been adopted to attain to the precision of pure method in regard to it.

I have shown for my part, with the assistance of Messrs. Berthol & Detzem, that not only the eggs of fish brought from very distant waters, preserve all their native powers of conception, but that by means of machinery extremely simple, they can be hatched much more quickly and certainly than as the female ordinarily lays them, so that two sets are obtained in the ordinary time of one.

This double result, that of carrying without injury eggs to a great distance, and their rapid fecundation, leads to the possibility of restocking all the streams of France, in a single season; so that it will cost nothing to the State save the necessary advances to organize an establishment wherein the spawn accumulated from all points where they are easily secured, should be confided to the care of canal keepers. I say it will cost the State nothing, because the advances can be readily more than repaid by a contribution, voluntarily self-imposed by the proprietors in exchange for the precious gifts made them, whether in the form of eggs or young fish.

The more I reflect on the means of realizing this useful enterprise, the more I consider it our duty to insist that France shall take the lead in giving a practical example of this great scientific discovery which can so increase public wealth by creating an inexhaustible means of production. It is a wish I express with all confidence, because I have visited the spots where the project has already received an impetus under the auspices of two engineers, who, notwithstanding their limited resources, have raised this year a million of trout, salmon and mongrels, the greater portion of which they showed me scattered through the ponds which they have dug along the Rhone and Rhine canal.

It only remains to profit by the experience and devotion of which they have, during two years, given so many proofs, and to place in their hands sufficient means to transform the precarious arrangements due to their perseverance into a veritable establishment where, as in the best regulated manufactories, the working details are ample and ready,

The locality which they have chosen is admirably well adapted to their purpose; a stream of fresh water, clear as crystal, runs from the foot of a sheltering hillock on a common of several acres, and then branches off into smaller streams.

This is so well fitted to fish hatching, especially of trout and salmon, it could be easily turned into a vast breeding establishment. It would be only necessary to substitute for the sieve-boxes hitherto used, (which offer obstructions and become less and less permeable,) simple plates placed longitudinally in parallel positions, which will divide the stream into narrow drains more or less numerous, through which the water will flow with some degree of rapidity. These drains, intended to receive the eggs, will be cut at intervals so as to form a succession of falls, in order to hasten the course and give an airing to the water, and produce conditions most favorable to the end in view. Each one of these drains should be extended in a meadow, without being confounded with the others, and finish by enlargement in a spacious basin, where the water in question alone has access, and whither will come the young fish when hatched, another place of destination being in store for them.

When this stream will have been so transformed into a vast establishment made after the plan I have indicated, it should be covered with a glass roof like a green house, admitting the light, and formed of moveable panes turning round so that the air may be readily admitted when deemed necessary.

To this should be added a little house to protect the workmen, where a workshop of all the necessary implements would be, and also a register of the results of each day's observations. The natural history of fish so obtained, would offer invaluable details. When this establishment would be ready, the problem would be reduced, simply procuring eggs sufficient to fill it, and then stocking all the streams of France. This would not be difficult to realize.

Being on the frontiers of Germany, Messrs. Berthol & Detzen are in communication with the fishermen of the river and great lakes, where are fish the most esteemed.

These fishermen have undertaken to give them all kinds of eggs. Messrs. Berthol & Detzem have already taken from Lake Federsee thirty-six gigantic fish, which so transferred I have seen in their basins. They are waiting now for a supply of young fish of this kind which bear the journey so easily, that I obtained three for the College of France, by simply putting them under the care of the conductor of the diligence, who kept them two days and a night in a vase. These fish hatch even in turf pits; so that they can be easily propagated in those of Piccardy, and in the least favorable waters. Their importation, then, will be a service rendered in fish-breeding.

In hatching fish in new waters, trials of their acclimation can be successfully made. I may give here striking examples in citing my experiments at the College of France, under circumstances where I did not promise myself success. Young salmon hatched in my laboratory, and placed afterwards in an artificial pond fed by a single stream of the water of the Arcueil, grew as well as if they had lived in the Rhine, as I was able to satisfy myself by a comparison. They are hardly four months old, and already their length is sixty millemetres, of which they have gained twelve during the last twenty-four days, a remarkable growth which may be attributed, without doubt, to the particular nourishment they receive, of which they show themselves greedy.

But to return to our hatching apparatus and the eggs which are in progress of development. Here a second problem is presented: what becomes after birth of the young fish hatched by millions in the narrow drains where the eggs are deposited? This second problem will not be more difficult to answer than the first. The arrangement of the locality will answer for all exigencies. As soon as the newly-hatched fish are strong enough to swim, they will follow the course of the stream, which will draw them to the meadow by the extremity of the glass house, through

which the current passes and leave them in the basin. There they will grow, but their number increasing every day, they cannot be long kept in this narrow reservoir. Larger basins then must be provided, where they can grow with proper nourishment. The dependencies of the Rhine and Rhone canal will fulfil this office, and on a scale so vast that there will be a crop greater than one would suppose room could there be found for. Thus: the government has on the borders of the canal, on the right and left, land in length 117,730 metres, and breadth 15 metres. Already there they have dug a certain number of ponds, well supplied with water. These ponds may be multiplied indefinitely, and connected by gratings, so as to prevent the admixture of the different kinds of fish, and stopped off occasionally in order to admit of being severally emptied, so that the young fish can be taken from them. But the ponds already dug on one side of the canal, are in the same part of the meadow with the receiving basins, into each of which the hatching trenches will carry a particular species; and it results from this, that to transfer the young of this species from the establishment where they were hatched to the ponds where they are to be converted into larger growths, there is almost nothing to do. The operation will be

self-accomplished so to speak; and from the single circumstance of a happy distribution of the different waters which run from one side to the other.

When the spawn have arrived at the growth of young fish suitable for stocking streams, the Rhone and the Rhine canal which runs between the two long lines of ponds where these fish are kept in reserve, will itself be the natural means to conduct them into all the waters of France by means of their intercommunications. To attain to this object, a jointed raft should be made of pieces of wood transversely placed, and connected by iron rings, and in the interstices of this raft should be fastened casks sufficient to hold the entire supply of fish. These casks should be provided with gratings, so as to be permeable, and contain water plants so that the young fish are not injuriously crowded.

The convoy so disposed should stop successively before each pond, and right and left the workmen attached to the ordinary service of the canal will empty into it the fish drawn from these drains; then, the cargo completed, the raft will be set in motion, and the casks, with their bottoms knocked out from time to time, will sow the fish as a plow would sow seed, if capable of doing thus as fast as it made furrows.

When the convoy will pass the point of junction of another water-course one of its sections as they are fastened by rings, could be detached as a wagon is from a train, and given to the engineers of the country traversed by this stream of water; these engineers will take the portion of the convoy in question, in order to empty it in the localities which appear to them the fittest to the purpose, and so ascertained beforehand, and then will return it to the point of departure, so that on its arrival thither, the great convoy may unite all the detached fragments, and render them to the establishment in order to take a fresh load, if the first has been insufficient, or to wait until a second crop requires a new journey.

The restocking of all the waters of France will be accomplished then easily, since, on the one hand the officers of the roads and bridges will answer for the requirements of the service, and on the other, the organization of the entire establishment, will require but a first expenditure of 22,000 francs, necessary for the construction of the shed, the guard-house, the digging of the ponds, the purchase of tools, and of twenty acres of ground to be enclosed in the common already given by the municipal council of the locality.

The first expenditure, or an annual credit of 8,000 francs, will suffice to commence the work,

to procure the species most valued, meet the cost of the daily labor, and give the production an infinite extension.

It will be perceived, therefore, that this sum is the smallest trifle, compared with the riches it will produce, for here nothing less is aimed at than to keep the supply of food up to the increased consumption, according to the duty imposed on governments; hesitation in such case is allowable only when an adequate trial renders success doubtful; but here experience has already furnished such positive results, that there cannot be the least doubt of the success of the operation.

Time presses, sir, and there are only three months before we come to the breeding season of salmon and trout. If at that time the apparatus is wanting we lose the most interesting part of the required work. I trust, then, you will give me the order for a credit of 30,000 francs, immediately open to the engineers of the Rhone and Rhine Canal, and I shall be happy to offer you my assistance for the organization of an establishment so founded and to take my part in the responsibility of an enterprise which will be a signal honor to the administration.

I cannot terminate this Report, sir, without speaking to you of the propagation of fresh-water

shell-fish; experiments which I have made under the hope of applying them to salt water shell-fish, whose multiplication would not be difficult to secure. Here, then, is an account of these experiments:—I placed at the College of France, in a basin, like that wherein my young salmon live, fed by a rivulet, a certain number of female craw-fish, all carrying under their tail their eggs. At the end of twenty-five days all these eggs were hatched, and the basin was usurped by a myriad of young craw-fish, which grew perceptibly. This result proves how easy it is to restock all running streams which an abuse of fishing has devastated, as though they had never been supplied. The question is reduced simply to setting apart at the breeding season, in the reservoirs in the form of little brooks communicating with creeks or rivers, all the females who have their eggs attached to the appendices of the tail, and not to allow their consumption until their offspring is hatched. This offspring, retained afterwards for a period in propagating streams, would not be allowed to swim through the gratings until capable of taking care of themselves.

As to salt water shell-fish, France possesses on the Mediterranean shore, immense salt marshes, where the females of these animals could also

be retained till the moment of hatching their eggs, as they carry them under the tail like the craw-fish. If the experiment succeed, and these spawn increase on the spot sufficiently fast, they may be fattened in these vast receptacles. If on the contrary, the conditions are unfavorable, they should be at liberty to go at large to seek another spot and stock our coasts.

But this is not the only use to which these marshes can be put. The sea-fish are too much liked not to suggest the means of multiplying them, either by artificial fecundation, or by transporting the young fish of certain kinds. In favoring the realization of such an enterprise, the state will have created in a few years, ponds much richer than the artificial piscines which were dug at so great an expense by the Romans, by the Gulf of Naples; piscines among which, however, those of Lucullus produced no less than four million sesterces, at a sale where presided Cato of Utica, in quality of tutor to the son of this famous epicurean. The care of these immense reservoirs would be confided to the custom officers of the coast, and would not involve, consequently expense beyond that of fishing in the waters.

While these measures were taken to secure the multiplication of salt-water fish, it would natu-

rally lead to the means of selling them for consumption at a price so moderate, that districts farthest off from their production could compete for having a supply of such alimentation for the laboring classes. You will find, sir, on this question materials for documents of great importance in practical details, from time immemorial, on the marshes of Commachio, whose waters are constantly changed by the flux and reflux of the Adriatic. There a population of about four hundred men, disciplined as if aboard ship, is occupied the year round, in fishing and preparing fish for all parts of Italy, with which they have a large commerce. It would be useful, then, to know the procedures by which they arrive at this last point.

Accept, Sir, the assurance of my most distinguished consideration,

COSTA.

I should perhaps, in justice to the two fishermen of Bresse, mention here that Dr. Haxo claims that they have had great injustice done them, both by M. Edwards and M. Costa. He insists that they are the original discoverers, that their discovery has been stolen from them by naturalists, who claim it as theirs, or as belonging to discoveries of a past century.

In referring to M. Edwards' report he says: "After, reading it, who would not be led to believe, that the processes of artificial fecundation were not perfectly known, at least by Savants? But notwithstanding this, M. de Quatrefages says not a word of them in the memoir he presented to the Institute in 1848; while on the other hand, when the letter which I addressed to that learned body on the 2nd March, 1849, was read by M. Flourens, it was received according to the testimony of Abbe Moigno, who was present at the meeting, with the most unequivocal demonstrations of surprise and satisfaction on the part of all the members of the Academy of Sciences. M. Milne-Edwards was then immediately appointed as one of the commission to examine my report in conjunction with Messrs. Dumeril and Valenciennes. How does it happen that he did not then inform his colleagues that the matter had been long before known? How was it that he did not then and there announce that not only the processes of artificial fecundation had been very many years before described by Goldstein, by Duhamel du Monceau, and by Jacobi, but that they had been successfully practiced in Scotland? Why did he wait before making any such statements, until he was officially charged by the Minister of Agriculture and Commerce,

to go to the place and examine the results of the labors of the two Vosgian fishermen? We leave all such reflections as these to the sense of the reader."

With this quarrel we are not directly interested; yet we may be allowed to express the opinion, that neither M. Edwards nor M. Costa would knowingly rob two humble fishermen of a single laurel. And yet there does appear to be something not quite right on the part of those naturalists who claim the discovery as theirs. It does seem a little singular that among so many claimants for the honor of the discovery, nothing had been said about it, until after Dr. Haxó presented it to the notice of the Academy of Sciences. That Gehin and Remy made the discovery there can be no doubt whatever, and to them belongs the credit of any valuable application.

CHAPTER VII.

GROWTH OF FISH.

We have seen by the Reports of M. Milne-Edwards and M. Costa, as well as from other sources, what the French Government have done, and are continuing to do for the recreation of Fisheries, by making large appropriations of money and appointing competent persons to conduct and superintend them.

The question naturally arises whether the enterprise justifies the amount of care, time, attention and money which the French Government is devoting to it. For the benefit of those who may regard the project as more Utopian than practical or beneficial, I will subjoin facts well authenticated. The following are the results of experiments made in Scotland with the *Salmo Salar* known by the common name of *Salmon*.

In November and December 1853 about 300,000 eggs were deposited in hatching boxes at Stormontfield, near Perth. In April and May, 1854 the hatching took place, and on the 15th of April the young fish were first observed at large in the troughs. In June 1854 the young fish hav-

ing attained a length of about one and a half inches were introduced to the larger sphere of the pond, where they were carefully fed and attended for twelve months. In May and June 1855, the young fry having attained the size of what is familiarly known as *smolts*, were marked by cutting off the adipose fin; about one in a hundred only were thus marked and liberated.

Some of the young fish remained in the pond but a large majority proceeded to the sea.

The largest of the smolts which left the place of their nativity in May and June measured no more than about seven inches in length and weighed from one half to two ounces only. In August 1855 a portion of them returned from the sea, after an absence of about two months only. The marked ones were weighed, and the smallest one was found to weigh $3\frac{1}{2}$ pounds, another weighed 5 pounds, one $5\frac{1}{2}$ pounds, one of $5\frac{3}{4}$ pounds, one of $7\frac{1}{2}$ pounds, and one of $9\frac{1}{2}$ pounds. This latter one measured over two and a half feet in length. The whole number that left the pond as smolts were above 200,000.

Such an increase of growth is almost incredible, especially when we consider that they received no attention whatever. It is reasonable to suppose that one-half of the 200,000 returned, in fact it would be no exaggeration to state that three-

fourths of the whole returned. Such an increase in actual wealth, is without a parallel in any other branch of human industry with which I am acquainted.

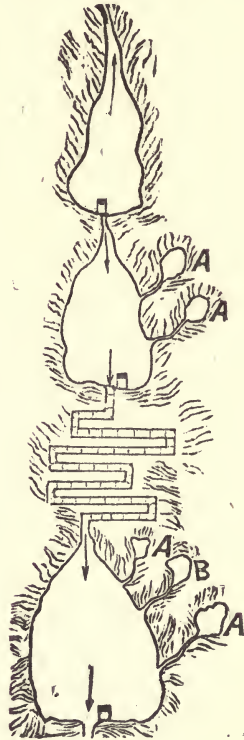
With proper care and suitable waters, other varieties of fish will increase in growth with a rapidity almost equaling that of the Salmon. Near Brussels, in the waters of the Boitsford successful experiments have been made with the Pike. In October 1852 about 2,000 Pike were placed in these waters and left as stock—none of which weighed over two pounds. Sixteen months afterwards, these fish were taken with the rod and line, many of them weighing six pounds and over. All of them were indigenous to those waters; but it was found that fish not indigenous increased much more rapidly in weight than the indigenous ones. Another Pike from neighboring waters placed in those near Brussels was found to have increased from $3\frac{1}{2}$ to $8\frac{1}{2}$ pounds in eleven months. I could add numerous cases of well authenticated facts, if I deemed it necessary to prove the rapid growth of fish.

From the above statement of facts, every reflecting mind must be convinced that the course pursued by the French Government is a wise one as far as political economy is concerned, and most unquestionably humanitarian so far as the social interest is concerned.

Our state and National Governments would confer a lasting benefit on the citizens of the State and Union, were they to follow the example of the French Government in this respect.

CHAPTER VIII.

THE CONSTRUCTION OF PONDS.



THIS cut will convey to the reader an idea of the plan adopted by Prof. Ackley and myself. The cut is not intended to represent the shape

of the ponds but merely the plan. These ponds are situated in a deep ravine, of about one hundred and twenty rods in length, the water being supplied from numerous large springs along the whole course of the ravine. The lower pond is much the largest, being some fifty rods or more in length, four or five rods in breadth, and some twenty feet deep. The middle one is about half the size of the lower one; the upper one is still smaller. It will be observed that the distance between the two lower ponds is much greater than it is between the two upper ones, and the distance that the water has to pass is greatly increased by putting in a flume zig zaged in the manner shown in the cut. This flume or aqueduct is constructed of plank, and is about three feet wide and near two feet deep, and has partitions placed in it every six feet through its entire length. These partitions are merely plank placed edgewise across the flume, and are ten inches broad. A notch is cut in the middle of the upper edge of each plank, of a V shape, for the purpose of directing the water through at one point, in order that the trout may the more easily pass up and down the flume. By means of this flume and its partitions (which are in fact a succession of little dams,) we convert a small stream of water into one of quite respectable magnitude.

The whole floor of the flume is to be covered with fine and coarse gravel, and when completed the water will be about six inches in depth, making as nice a place for them to deposit their eggs as the most fastidious trout could desire.

I may remark here that although we do not intend to propagate trout by the natural process, yet it is absolutely necessary that they have all the facilities for depositing their eggs, or we should fail altogether in propagating either naturally or artificially, as trout must have shallow, running water to deposit their eggs, or they will cease spawning altogether. A great many kinds of fish require nothing more than a simple pond for breeding purposes, all of which will be described in the proper place.

For trout it is very desirable to have a succession of ponds, in order to keep the different broods separate, or the young fish will be devoured by the older ones. I have seen a two year old trout swallow a yearling. This may look, to persons unacquainted with the habits of this fish, a little *fishy*, but it is true nevertheless.

The points in the cut marked A, are springs, the heads of which are formed into pools of about thirty feet in diameter, and eighteen inches deep, the bottoms being overlaid with gravel. B

is the hatching-house described in a former chapter.

After the young trout attain to the size of about an inch or little over in length, or are old enough to take food, they should be transferred from the hatching-house to these pools where they are to remain for a year; they are then to be transferred to the upper pond where they remain another year; on the following year they are let into the middle pond by means of a spout or conductor, with a gate at the upper end; this conductor should be made of durable material, and be laid sufficiently low in the dam to let the water together with the fish run from the upper into the middle pond.

The same arrangement is made in the middle dam, and the fish after remaining in the middle pond a year, are let into the lower pond. The pools and the two upper ponds are to be supplied from year to year by successive crops so that none of them are empty.

When springs have not sufficient length for such a succession of ponds, or perhaps only one dam, the young trout may be kept for a year in tanks or a pool, the water being supplied by a spring, and then transferred to the pond, where they must run their chance of being devoured; if, however, the old fish are well fed, the probability is, a great proportion of the young fry would escape.

The spill, or place where the water makes its exit when the ponds are full, must be protected by wire screens to prevent the escape of the fish.

I would observe here, that the foregoing arrangement of ponds and spawning grounds are essential to the rearing of trout, only; for all other kinds of fish mentioned in this work, no such arrangement for spawning purposes is needed, but simply gravelly shoals near the margins of the pond will be sufficient.

In a great majority of cases, fish ponds can be so arranged as to serve the double purpose of a fish-pond, and at the same time greatly beautify the grounds. The size of the pond should be proportionate to the supply of water, or the water may become too stagnant to have healthy fish. The quality of the water is however greatly improved by introducing aquatic plants, which also adds much to its beauty. Among the most suitable plants for this purpose, I would mention the white water Lily, *Nymphaea Odorata*, Egyptian Lilly, *Calla Ethiopica*, Arrowhead, *Sagittaria Sagittifolia*—for small ponds, but for large ones to these might be added the Sacred Bean, *Nelumbium*, *Speciosum*, which is a large lily with pink flowers, *N. Luteum* with yellow flowers; the latter is indigenous to the Southern States. The

shores of ponds may be planted with various species of the more aquatic Iris, or sword-leaf lilies. All of the former should be planted in the water near the margin. These are all beautiful flowering plants, and will flourish in such situations.

Great care should be had in constructing dams, with reference to strength and durability. There should be an ample spill in case of floods, with strong wire screens to prevent the escape of the fish; these screens may be made of iron wire of $\frac{1}{4}$ inch diameter, cut in pieces of a length equal to the depth of the spill; this may be one foot or more; these rods should then be set at equal distances from each other in a frame of wood, and close enough to prevent the passage of the fish; this frame is then to be securely fastened at the outlet or spill. Screens for young fish when they are quite small, may be made of wire cloth such as is used for seives, the meshes of which should be small enough to prevent their escape.

CHAPTER IX.

BROOK, OR SPECKLED TROUT.

This fish belongs to the family *Salmonidæ*, of Naturalists, some of the characteristics of which are, body more or less scaly, two dorsal fins, the first articulated rays, the second adipose, or fatty. The different species inhabiting fresh and salt water.

The Brook Trout, then, belongs to the genus *Salmo*, species *Salmo Fontinalis*. Its beautiful figure, its gay colors, and the gracefulness of its motions, must be seen to be appreciated. No description that has ever been given, does him justice. His haunts are among the wildest and most picturesque scenery imaginable. The following cut represents a female Trout, which we have in our pond, and which has become very tame.

It is found from our most northern States, as far south as Virginia—rarely in the western States. In a few streams in north-eastern Ohio they were found in abundance, thirty or forty years since, and a few are yet to be found on the head waters of the Chagrin river; but in a



NAIAD QUEEN.

very short period of time, they must become extinct, unless measures are taken for their reproduction.

This charming fish is equally the delight of the sportsman, and the epicure. It stands unrivaled as a game fish, and for the table is thought to have no superior, particularly when in its highest condition, which is just before the spawning season.

They are found in their highest perfection in the tributaries of Lake Superior, and its outlet particularly at the Saut Ste. Marie. In these immense rapids are taken the finest trout that are found in the American waters. Very large trout are taken in Lake Superior, near the mouths of trout streams, where the shores are rocky, and among its numerous islands, particularly *Isle Royale*.

The body of this fish is covered with small scales, hardly observable to the naked eye in small specimens; the upper part of the body and head are most beautifully mottled like tortoise shell, the colors being greenish brown with yellow; colors more brilliant on the sides with the addition of very bright vermilion spots, in irregular rows, above and below the lateral line. A portion of the belly and sides, being tinted with carmine, the pectoral and ventral fins or-

ange, inclining to red, with a dark margin; anal fin red, with white margin, and a black streak between the white and red; caudal fin darkish red, inclining to brown; first dorsal fin yellowish, barred or spotted irregularly with black.

All these colors are greatly heightened at the spawning season, particularly in the male. At this time, he has projecting from the tip of the lower jaw, a conical knob, which is received in a corresponding groove in the upper jaw. Its great brilliancy of color at this season, together with this peculiarity of the jaws, has led De Kay into the error of describing it as a distinct species, under the name of *salmo Erythrogaster*, or red-bellied trout. He has also described another fish, under the name of spotted troutlet, *Baione Fontinalis*, which is nothing more than the young of the brook trout, thus making three distinct species out of one. The cut at the head of this article, gives a correct idea of the form of the speckled trout; it was drawn from a living fish, the Naiad Queen, one of the parent fishes exhibited at the Cuyahoga County Fair, in 1854.

In size, the brook trout varies a good deal; a few have been caught weighing ten pounds, though they rarely attain to this size, five pounds being considered a very large fish.

The Brook Trout inhabits none but the pur-

est waters, such as mountain streams, spring brooks, and lakelets, in which the water is pure and cold. Their growth depends much upon the size of the stream they occupy; if in a small spring brook, they would rarely exceed from four to six ounces in weight; but if placed in a large river, or lakelet, they may attain to as many pounds, or even more.

Their food consists of aquatic insects, and small fishes. They are remarkably shy and wary, but when domesticated, will become so tame and gentle, as to take food from the hand. Of all fish, this is the most desirable for fish culture, and should be selected in preference to any other, provided the quality of the water will be congenial to its wants.

SPAWNING.

The spawning season commences about the first of October, and continues nearly two months, but a majority are through by the 15th or 20th of the month. They invariably seek very shoal, gravelly rapids for depositing their eggs, and prepare their beds by digging a cavity of from one to two feet in diameter, and two or three inches in depth; by agitating the water in these beds, the fine sand and earthy matter is got clear of, leaving the bottom of the bed covered with clean, coarse gravel.

In this the eggs are deposited, together with the milt, one pair of fish always occupying one bed; several pairs of trout may, however, occupy the same rapids or ripple. You will rarely find them occupying a rapid, unless there is a deep hole or hiding place close at hand and above the ripple. When frightened, they immediately run to their hiding place; but if not further disturbed, will in a few moments return to their bed.

ARTIFICIAL BREEDING.

In order to procure eggs for artificial breeding, the parent fish must always be taken on the spawning beds, and *after* they have *commenced* depositing their eggs, or they will be premature and useless, as they cannot be impregnated. If the eggs are mature, they will flow from the female trout, with a very slight pressure, as the cellular tissue will have been absorbed, and the eggs lie loosely in the oviduct.

HOW TO CATCH THEM.

The parent fish must be taken by means of nets, as they will not touch any kind of bait while engaged in spawning. A common landing net does well for this purpose, where they are in a very small stream. A very excellent net, is one that is made after the fashion of a seine. It should be three or four feet long, by two

and a half feet wide; the lower, or lead line, mounted with sinkers, and the ends mounted with a couple of sticks, or handles, (termed by fishermen brails.) These handles should be about four feet long. Each end of the lead line is fastened to the lower end of the handles; the upper, or cork line, is to be fastened the width of the net above where the lead line is fastened. By taking hold of the two handles, you can spread the net out before you; standing between the handles, in this way, it can be slipped under banks, where they hide, or in holes, and not unfrequently they can be dipped up while running from their beds, if you are standing in the stream above them.

HOW TO EXTRUDE THE EGGS.

The manner of extruding the eggs, has been given in a previous chapter; also their management.

INCUBATION.

Their term of incubation will depend somewhat upon the temperature of the water in which they are placed. With us the young trout begin to make their appearance in eight weeks, the water being 42° Fahrenheit; but some will not make their appearance until two or three week later.

TREATMENT OF THE YOUNG FISH.

After the young fry leave their eggs, they may be suffered to remain for a few days, in the hatching boxes, or they may be removed at once into small tanks, or boxes, having fresh water running through them; the place where the water enters, and where it makes its exit, being guarded by wire cloth, to prevent the escape of the fish. A box three feet long, by two feet broad, and one foot deep, would be sufficiently large to hold one or two thousand. When about two months old, they should be placed in larger tanks, or what would be still better, a pool of water, fed by a good spring. It would be well to have a nice, clean, gravelly bottom, with some large stones thrown in, which would afford them hiding places. If the pool could be shaded from the rays of the sun, it would be much better, as the water would be cooler, during the hot days of summer.

FOOD.

The young fish need no feeding, for about one month after they leave the egg. As they draw, or receive their nutriment from the umbilical vesicle, or bladder, which is shown in the cut, when this bladder, is absorbed, they will need feeding, but only in small quantities, as the surplus falls to the bottom, and decomposes,

contaminating the water and rendering the fish unhealthy. It has been ascertained that the lean flesh of animals, when boiled, is an excellent article of food for young fish, or even old ones.

As the young fish are very small, it is necessary, to hash it up into very fine particles, or they will not be able to swallow it; in fact, it should be pounded or grated very fine, but as they increase in size, it may be given in coarser particles. The flesh of other kinds of fishes, where they are plenty, would be an excellent substitute for the flesh of animals, either cooked or uncooked; I think this kind of food, preferable to any other.

PONDS.

It would be well to keep the young fry in small pools, or tanks, until they are a year old, before removing them into the pond, or stream, as you can have them under your immediate observation and inspection, which is of a good deal importance, at this tender age. After they are of a suitable age to be turned into the pond or stream, as the case may be, if very numerous, they will still need to be fed, occasionally, once per week at least, but if fed all they will eat, it would be still better and far more profitable.

MORE ABOUT FEEDING.

It is perfectly astonishing how rapidly they grow.

after the first year, particularly if well fed; and as a lean and poor conditioned fish, though a trout, is one of the most miserable of dishes ever set upon the table, the fish intended for use, should be taken from the pond, selecting the largest ones, and put into a tank or pool, three weeks or more before killing, and fed all they can eat; in a word, they should be *stall fed*.

This may seem a little fanciful, but I can assure any one who will try the experiment, that he will find his account in so doing. In order to be able at any time to take a quantity of fish from your pond, it is only necessary to have uniform places of feeding, and they will generally stay at or near these particular locations, where they can be taken either with a rod or a net.

BEST METHODS OF ANGLING FOR TROUT.

There is no fish of its size, that affords such excellent sport as the Brook Trout. It is considered a prize worthy the most accomplished angler, and a dainty always welcome to the most fastidious epicure. Among the patrons of this captivating sport, have been found persons of the highest attainments. Statesmen, Divines, Poets, and in fact, persons from all classes of society, have been zealous patrons of what has been not

unaptly termed the gentle art. It has been the theme of some of the most brilliant poets of modern times. No angler can read the following lines from Thompson without feeling a thrill of delight:

“Just in the dubious point, where with the pool,
Is mix'd the trembling stream, or where it boils
Around the stone, or from the hollow'd bank
Reverted, plays in undulating flow;
There throw nice-judging, the delusive fly;
And as you lead it round in artful curve,
With eye attentive mark the springing game.
Straight as above the surface of the flood
They wanton rise, or urged by hunger leap,
Then fix with gentle twitch, the barbed hook;
Some, lightly tossing to the grassy bank,
And to the shelving shore, slow dragging some,
With various hand, proportioned to their force,
If yet too young, and easily deceived,
A worthless prey scarce bends your pliant rod,
Him, piteous of his youth and the short space
He has enjoyed the vital light of Heaven,
Soft disengage and back into the stream
The speckled captive throw. But should you lure
From his dark haunt beneath the tangled roots
Of pendant trees, the monarch of the brook
Behooves you then to ply your finest art.
Long time he, following cautious, scans the fly;
And oft attempts to seize it, but as oft
The dimpled water speaks his jealous fear.
At last, while haply o'er the shaded sun
Passes a cloud, he desperate takes the death
With sullen plunge. At once he darts along,
Deep struck, and runs out all the lengthened line;
Then seeks the farthest ooze, the sheltering weed,
The cavern'd bank, his old secure abode,
And flies aloft and flounces round the pool
Indignant of the guile With yielding hand,

That feels him still, yet to his furious course
Gives way, you, now retiring, following now,
Across the stream, exhaust his idle rage ;
Till floating broad upon his breathless side,
And to his fate abandoned, to the shore
You gaily drag your unresisting prize."

FISHING TACKLE.

The implements for trout fishing are a rod eleven or twelve feet long, if for a single-handed rod ; if for both hands, or two-handed rod, it should be sixteen or seventeen feet in length. A landing net and kreel, or basket for carrying your captured fish. Near the lower end of the rod should be attached a reel capable of holding one or two hundred feet of line ; the line may be of silk, hair and silk twisted together, or hair alone, or even linen makes a good line. For myself, I prefer a silk line. To the end of the line is attached about nine or ten feet of silk-worm gut ; at the end of the gut is attached an artificial fly, three feet above this is attached another, and three feet above this, still another. These are all that is necessary for fly fishing, which affords by far the prettiest sport. The very best of fishing tackle of every variety, can be procured of Mr. Conroy, New York. His rods are unequalled, and so I may say of all his fishing tackle. Very many rods are sold as Conroy's which are not of his make. I would

therefore advise persons wishing good rods and tackle, to make their purchase of Mr. Conroy himself, and they will not be disappointed.

ARTIFICIAL FLY.

Very little can be said, by way of directing the new beginner how to use the artificial fly, as it can only be learned by practice. I will say, however, that the new beginner should commence with one fly, or two at most; nor should he attempt to make a long cast at first. After he gets sufficiently dextrous to throw his fly at a short distance, to a given point, he may practice his hand at longer distances, and when sufficiently expert, he may add the second and third fly. In lakes or broad rivers, when the water is clear, it is necessary to make long casts, as the trout are so very shy, they will not rise close to you, particularly the larger ones. When making a cast, the flies should be dropped very gentle on the surface of the water, and should not be suffered to remain stationary at one place, but is to be drawn along by a trembling motion communicated to the rod, by means of the hand; great care should also be taken, not to let the line drop on the water, but simply the flies, and a portion of silk gut leader, and these so gently as not to create suspicion.

DROP FISHING.

Another method of taking trout, is that which is termed drop fishing, which is merely using a baited hook, attached to the end of the line, having a sinker placed upon the line, about one foot above the hook. The most common bait, by far, is the angle worm, too well known to need a description. Grasshoppers are also excellent bait, and may be used on the surface of the water, or sunk beneath it. Small fish are sometimes used with great success, particularly when fishing for large trout.

DON'T FRIGHTEN THE FISH.

Too much care cannot be taken, to avoid being seen by the fish, for if once frightened no kind of bait will tempt them to bite.

The six following cuts were taken from microscopic drawings, made by myself with great care. Fig. 1 represents the spermatozoa of the male trout: one drop of the sperm was put in six ounces of water, and one drop of this diluted sperm, between two peices of plate-glass, was placed under the microscope with a high power. Countless numbers of spermatozoids were seen moving rapidly in every direction; they were simply ovoid bodies, having no caudal appendage.

The cut conveys a good idea of their appearance.

They continued to move about with less and less vigor for about an half hour, when all motion ceased, owing no doubt to loss of vitality.

Fig. 2 represents the egg of the trout as it appears when just extruded from the female, magnified about sixteen diameters. The egg is filled with a multitude of cells of various dimensions as shown in the cut.

Fig. 3 gives the appearance of the egg eight days after impregnation. The principal change observable is that the cells are all congregated to one side of the egg. When the egg was agitated sufficiently to scatter the cells they were immediately attracted together as before.

Fig., 4 represents the appearance of the egg at twenty-five days after impregnation. The whole length of the embryo fish is easily traced; the head and eyes are however by far the most distinct. Blood vessels are distinctly seen running in various directions, the aorta in particular being strongly shown.

Fig., 5 represents the egg at thirty-five days after impregnation. It will be seen that quite a change has taken place in the last ten days: Its vascularity is increased immensely; the vessels given off from the aorta being much longer, their ramifications much more extensive, and the outlines of the embryo fish more distinctly mar-

ked than in the preceding cut: The cells have also decreased in size, their substance having been taken in part into the circulation.

Fig. 6 shows the appearance of the young trout when it leaves the egg, highly magnified. Nothing could be more beautiful than every part of the fish when placed under the microscope, its transparency affording to the observer a perfect view of the circulation in every part; the corpuscles of blood being not only shown in the arteries and veins, but also in both cavities of the heart.

In the tail and some other parts of the fish the circulation may be seen making the entire circuit. The cells by this time have become much reduced in size, and appear in clusters owing to their absorption in the more immediate vicinity of the vessels. At the time of its birth the only fins developed are the pectorals—*a* natural size of the egg—*b* natural size of the trout when it leaves the egg.

MICROSCOPIC VIEWS—HOW OBTAINED.

In order to get a good microscopic view of the living young fish, or eggs, during the process of incubation, they should be placed in a glass cell, made sufficiently tight to hold water. By this means the young fish may be kept alive for quite

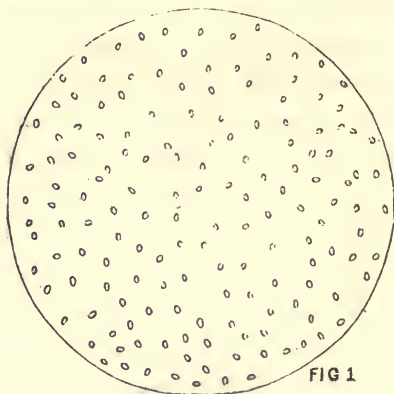
a length of time, by changing the water occasionally.

This cell is made by taking two pieces of thin plate glass of about three inches in length by one inch in width, and between these is placed a piece of cork or wood about the same size, and about one-eighth of an inch in thickness. These three pieces are to be cemented together by means of gum shellac dissolved in alcohol. Before cementing them together, however, the cork or wood, whichever it may be, should all be cut away, except enough to close the two ends and one edge of the two pieces of glass, thus forming a cell, the two sides of which is formed of the plate glass, and the ends and bottom are formed of cork or wood. The cell stands upon its edge and is to be filled with water, into which is placed the young fish or the eggs to be examined. The microscope, of course, must be placed in a horizontal position, with a strong gas or lamp light in front of the cell containing the fish or eggs, and the view will be most satisfactory.

I made some very interesting experiments by means of the foregoing fixtures, on young trout. After wounding the fish in some part, he was placed before the microscope in the cell, and the recuperative process could be plainly seen, from

time to time, until the recovery was complete.

The above arrangement of cells, is also a most convenient one for examining many kinds of aquatic insects and animalculæ.



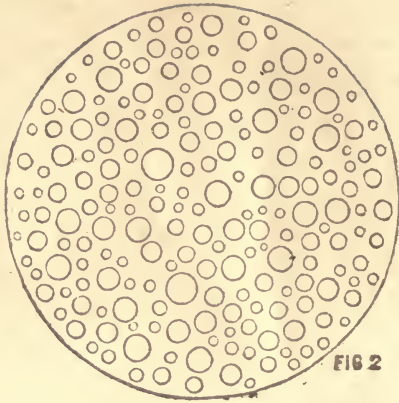


FIG 2

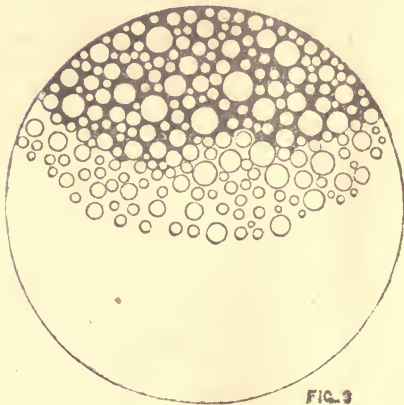


FIG. 3

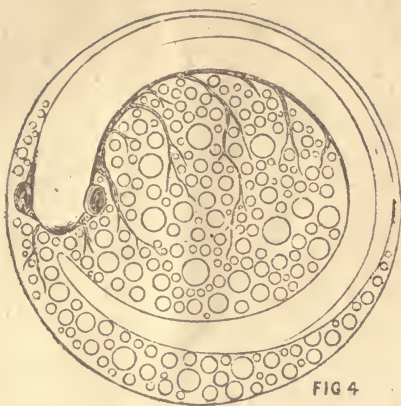


FIG 4

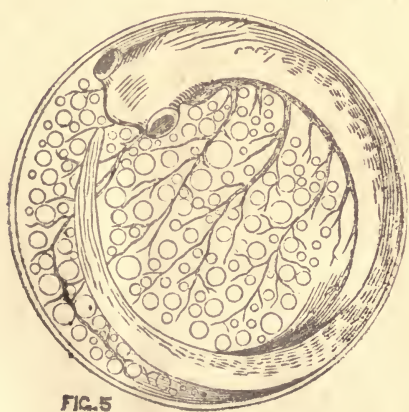
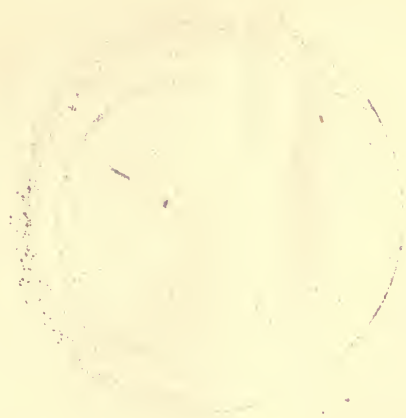


FIG. 5



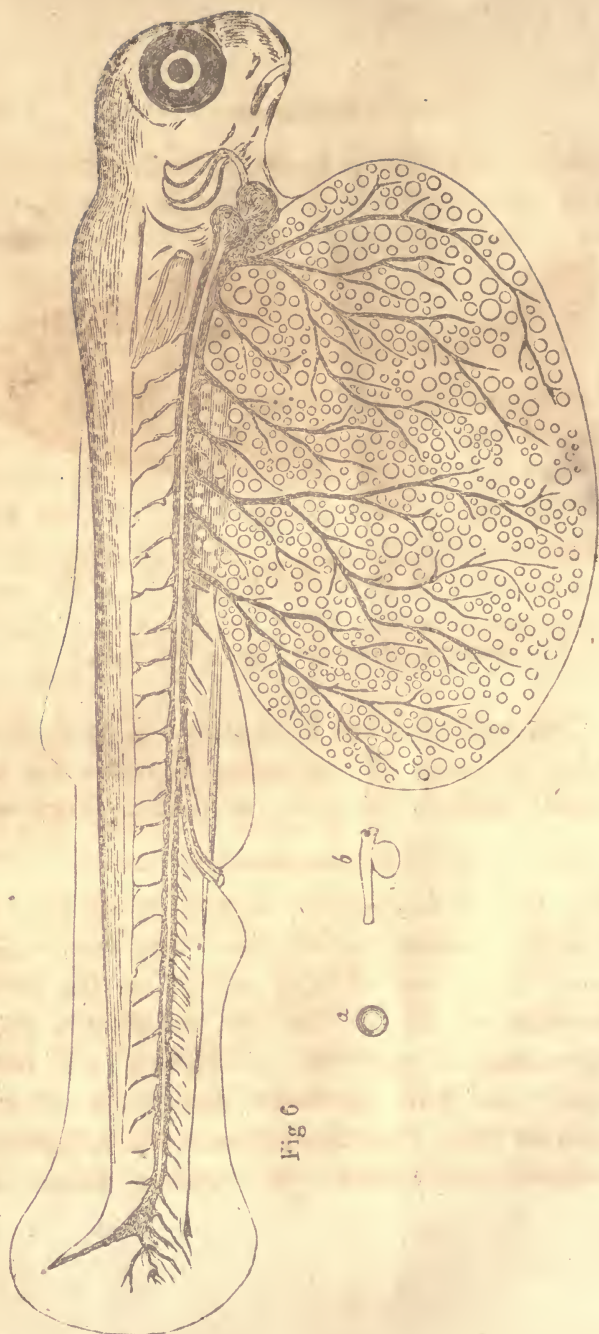
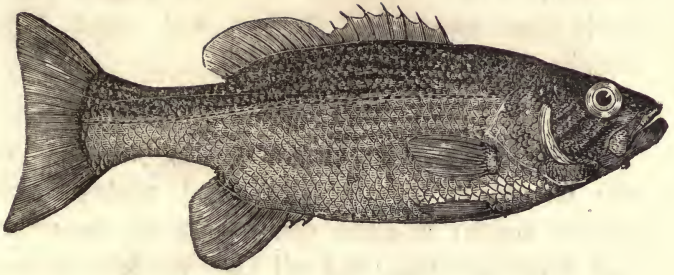


Fig 6



CHAPTER X.

GRYSTES NIGRICANS; OR, BLACK BASS.

THIS noble fish has been described by De Kay under the name of *Centrarchus Fasciatus*, and by Agassiz, under the name of *Grystes Nigricans*.

DESCRIPTION.

“The body is compressed, oval, back arched; of a dusky greenish color, often with transverse bands, with three oblique stripes on the preoperculum, or cheek.” The cut, (which is a good representation,) and the description, are both taken from Prof. Kirtland’s description of the fishes of Ohio. The Black Bass, when full-grown, measures from twelve to eighteen inches in

length. The largest one, by far, that I have ever seen, was caught last summer by Prof. Ackley, in the Cuyahoga river, its length was a little over twenty-two inches, and must have weighed eight pounds, or more.

WHERE FOUND.

This fish is found from the St. Lawrence to the tributaries of the Ohio, and perhaps still farther south; is quite common in all the rivers and lakes of Ohio, and, all the Western States.

He is a bold biter, and when hooked, fights with the most determined fury to the very last, affording the best of sport to the angler, and is excelled but by a very few fish when placed upon the table.

The Black Bass is among the best of fishes to rear in artificial ponds. It is not, however, so well suited for small ponds, it being a large fish. I should not think it advisable to introduce it into a pond that covers less than half an acre. It would be well to place in the same pond, the fish known as the Chub, as they are very prolific, and would afford an abundance of food for the Bass.

BREEDING.

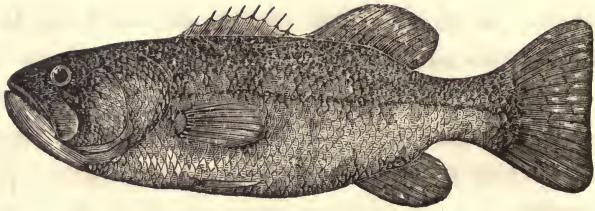
The Black Bass deposits its eggs in the months of April and May, in shoal water, digging

holes, or nests, like the brook trout. Their eggs may be procured in the same manner as that of the trout, and the same rules will apply, in the treatment of the eggs, and the young fish, as with the trout; or they may be suffered to deposit their eggs, and leave them to chance, when you do not wish to rear them in great numbers.

Their term of incubation is brief, as is the case with most of fishes that deposit their eggs in the spring of the year, not being over two or three weeks.

BEST METHODS OF ANGLING.

The best bait, by far, is the live minnow; he will, however, take a dead one, if played about lively, or when used on a trolling line; he also takes the common angle worm, but it is by no means as tempting as the minnow; he will also rise to the artificial fly, mornings and evenings; a large gaudy salmon fly being the most likely to attract his attention.



CHAPTER XI.

GRYSTES MEGASTOMA ; OR, LARGE-MOUTH BLACK BASS.

This fish has been identified with the common Black Bass, (*Grystes Fasciatus*), but is by no means the same fish, differing in many respects, both in its habits and physical structure, and has not been described in any work on American fishes, so far as I can learn.

The great distinguishing feature of this Bass, is its immense mouth, which has induced me to call it *Grystes Megastoma*, or large-mouthed Bass.

In its general form, it resembles the common Black Bass, though somewhat thicker. The head is much larger in proportion to its size, and if a vertical line be drawn, passing through the center of the eye, we shall find that the end

of the upper jaw projects back, or behind the line quite a distance; whereas, in the common Bass, the jaw will not reach as far back as the line. The scales are much larger, and thickly set over the gill covers. Back, of a dark, greenish, olive color, fading gradually to white underneath. If found in dark-colored water, the white will be tinged with a pinkish hue. A darkish mottled band, of about half an inch in width, embracing the lateral line, traverses the whole length of the body.

Br., rays 6; Dor. 23, Spinous 9, Soft 14; A 14, Spinous 3, Soft 11, C 20; V 6, Spinous 1, Soft 5, P. 13:

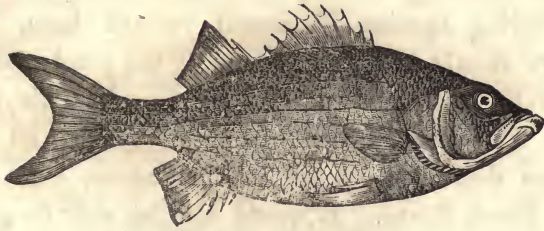
The cut is a good representation of this fish, and when full-grown, measures from twelve to twenty-four inches in length, weighing from four to ten pounds, being a much larger fish than the common Black Bass.

WHERE FOUND.

They are found in the bays of Lake Erie, and the mouths of some of its rivers. The little lakelets, lying twenty or thirty miles south of this city, abound with them. Great numbers are sold in the Cleveland market, brought from Toledo and Sandusky, at which places they are called the Cove Bass.

The places here mentioned are the only ones that I have a personal knowledge in which they are found; but I have no doubt they are abundant in the lakelets of Michigan and Wisconsin, and probably many other locations, though it has not so general a distribution as the common Bass.

This fish would do well in artificial ponds, provided the ponds were of good size. It is not, however, as well-flavored as the common Bass, nor does it afford as good sport to the angler, being less active, and not holding out near as long. Bites freely the live or dead minnow, also the spoon and squid. Habits in spawning in all respects as the common Bass. The eggs and young fish may be treated in the same manner as the Black Bass.



CHAPTER XII.

LABRAX MULTILINEATUS.—WHITE BASS, SOMETIMES
CALLED WHITE PERCH.

This is a beautiful fish, and is very abundant in Lake Erie, and many of its tributaries. It is not so large as the preceding species, rarely weighing over two pounds. As an article of food, it has but very few superiors, and gives fine sport to the angler.

The cut is a good representation of this fish which is so well known as hardly to need a description.

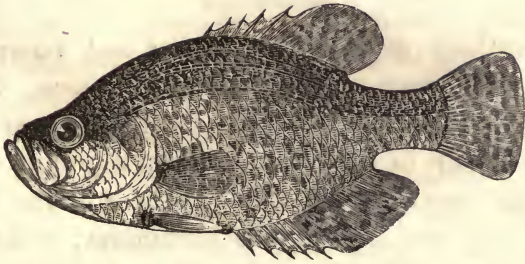
Its color is light olive on its head and back, sides silvery white, traversed by numerous interrupted dark lines, the number varying in different specimens.

This fish would thrive well in artificial ponds of moderate size. They would not require treatment differing in any particular from the two preceding species. I would remark here, that there should be in some part of the pond a shoal, gravelly bottom for them to deposit their eggs in. This arrangement is necessary for all the fishes described by me in this series, excepting the Brook Trout. It would also be well to place in the same pond with these voracious fishes, the fish known as the chub or dace, which are prolific, their offspring affording an abundance of food for the large fish.

The White Bass spawns in the month of May. The treatment of their eggs and young fish, should be the same as in the preceding species.

THE BEST METHODS OF ANGLING.

Very little skill is required in taking this fish. He is a greedy biter, taking the live or dead minnow eagerly, and at certain seasons will take the artificial fly, or even a piece of red and white rag fastened to the hook.



CHAPTER XIII.

CENTRARCHUS HEXACANTHUS—GRASS BASS—ROACH.

THIS fish for beauty is hardly excelled by any other species of the Bass; and, as a pan fish, is thought by many to equal the best. It is perfectly adapted to artificial ponds, as it prefers sluggish to running waters.

WHERE FOUND.

It is found in great abundance in the bays of Lake Erie, and in the mouths of its tributaries; also in the little lakelets lying south of the lake. I presume it is distributed throughout our entire Western country. Wherever I have

found the large-mouth Bass, I have invariably found this fish.

DESCRIPTION.

Forehead and back maculated and variegated with dusky spots, on a ground of sea green. Similar spots extend downwards, upon the upper half of the body in irregular bands, on a ground color of light green or yellow. The sides of the head and body are silvery and iridescent; below of a delicate white. Dorsal, anal and caudal fins bordered with a series of irregular dusky spots more distinct in old than in young specimens. Pectoral and ventral fins, ferruginous, or yellowish. Length, six to ten inches.

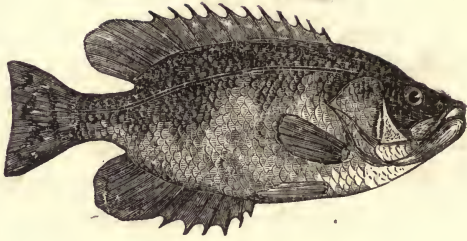
The cut is taken from a living specimen which I have at the present time, and will convey to the reader a good idea of its appearance. This fish is a small feeder. In this respect it differs from the Bass family. It will be perceived by looking at the cut, that the anus is situated but a little distance posterior to the ventral fins. The anal fin being very long, the abdomen is, therefore, remarkably small, embracing a very limited space. It is a hardy fish, and very tenacious of life. The specimen from which the drawing was taken, was wrapped in a piece of paper when taken from the water, and carried in

my coat pocket for over four hours, and when placed in a bucket of water soon revived, and seems at the present time to enjoy excellent health. In warm weather, however, it would not, in all probability, survive so severe a test of its vital powers.

It is a little smaller fish than the White Bass, weighing from one to two pounds when full grown. Spawns in the month of May. Their management the same in all respects as the preceding species.

BEST METHODS OF ANGLING.

A small minnow is the best bait by far for this fish, though it will bite very readily the angle worm, and I have frequently taken them with the squid.



CHAPTER XIV.

CENTRARCHUS ÆNEUS—ROCK BASS.

THIS is one of the very best of fishes for the table; and, for its size, can hardly be beaten as a game fish. It is, however, a small fish, rarely reaching a pound in weight. Nevertheless, it would be a very valuable fish to introduce into artificial ponds, being hardy, and well suited every way for this purpose.

The cut is a very perfect representation of this Bass.

It has a wide-spread distribution, being found from the State of New York through the entire Western country. Spawns in the month of May on gravelly shoals. Treatment of eggs and young fish same as in the preceding chapter.

BEST METHODS OF ANGLING.

The Rock Bass, like all other species of Bass, is a bold biter, taking freely the live or dead minnow, or even the angle worm does very well where minnows cannot be had.

This embraces all the fresh water Bass with which I am acquainted. There is, however, a fish in the Southern and Southwestern States, known by a variety of names—Carolina Weak Fish, White Salmon, Trout and Growler—which is undoubtedly a true Bass, and has been described by some one, under the name of *Grystes Salmonides*. It is said to be an excellent table fish, and I have no doubt would be every way suitable to introduce into artificial ponds.



CHAPTER XV.

COMMON PICKEREL—*ESOX RETICULATUS*.

THIS is a common fish throughout the United States, except, perhaps, the Southern. We have, indeed, three or four species of this fish, but it is only the smaller species that I would recommend as suitable for fish culture, and these only when we can avail ourselves of large ponds. I will except however from this statement the fish termed "Long Island pickerel" which rarely exceeds one pound in weight, and has been named by Dr. De Kay *Esox Fasciatus*.

I will remark here that every species of the pickerel, including the *Esox Estor*, or Mascalonge, the *Esox Ohioensis*, or the Pike of the Ohio river and its tributaries, all belong to the Pike family, and the fish commonly known by the name of Pike, found in our great lakes, and the fish found

in the Ohio and its tributaries, known by the name of Salmon belong to a genus of fish termed by naturalists *Lucioperca* and are a true perch, none of which I would recommend as a suitable fish for cultivation, except the *Perca Flavescens* or yellow perch.

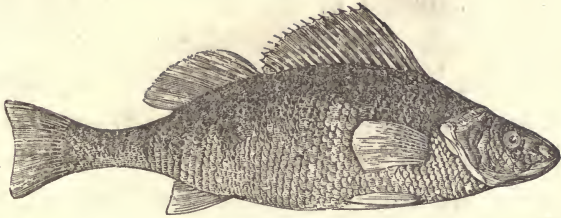
The common pickerel is so well known that I need not give a particular description of it. It is one of our most voracious fish weighing from three to fifteen pounds: is considered by many an excellent fish for the table and by some as an inferior one. The truth is, certain seasons of the year it would form a feast for an epicure while at other seasons it is not so good. This, however, is no characteristic of the pickerel but in more less degree is common to all fish.

The cut conveys a very correct idea of the appearance of this fish, as it does in fact of the whole family. It is among our most beautiful fish, and is a bold biter, giving excellent sport to the angler.

It spawns early in the spring, seeking the marshy edges of sluggish water to deposit its eggs. The same rules in relation to procuring their ova and their treatment that apply to the trout are proper in this instance, excepting that

the eggs need not be placed in cold running water.

The best method of angling for them is to use the live or dead minnow, though they readily take the spoon or squid.



CHAPTER XVI.

PERCA FLAVESCENS—YELLOW PERCH.

THIS is one of the most beautiful of our fresh water fish. Its qualities as a table fish rank very fair, particularly in winter and spring.

It is a hardy fish, and being perfectly adapted to sluggish waters, would be among the very best to introduce into artificial ponds.

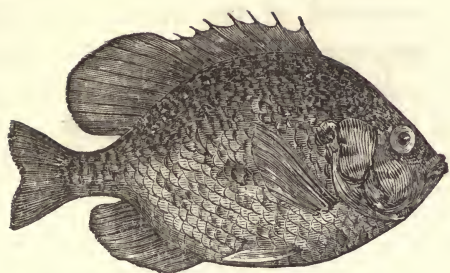
When full grown it weighs from one to three pounds, being a very suitable size for fish culture.

It is widely diffused throughout our country, being found as far North as 47° to my certain knowledge, and South to 38° N. Latitude. In Mr. Herberts work on American fish, he says this fish has made its way to the waters of the Ohio, through the Ohio Canal. Now I will venture the assertion "that the memory of man runneth not

to the contrary" when they were not abundant in very many of the tributaries of the Ohio: yet I have no doubt many have passed through in the manner mentioned by Mr. Herbert, as has been the case with many other kinds of fish.

The cut conveys a good idea of its figure: its sides are yellow varying from greenish to a golden hue: its back and sides are banded with seven or eight dark, vertical bars: Pectoral, ventral, and anal fins are of a deep golden orange hue: its dorsal and caudal fins are of a greenish brown color.

Spawns in the month of May: is a bold biter, and gives good sport, tugging away at the line like a little hero, for a number of minutes, before giving up. Takes the live or dead minnow eagerly and it also will take the angle worm very well. Its treatment, or that of its eggs and young, need in no particular, differ from the preceding species.



CHAPTER XVII.

POMOTIS VULGARIS—SUN FISH.

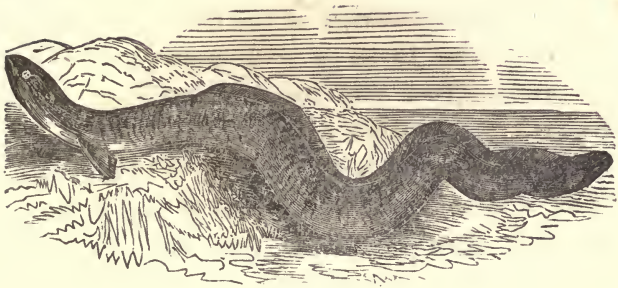
THIS beautiful little fish has a wide geographical range, being found in almost every part of the United States. There are several species of them but I think there is no preference in the kind to be selected, though perhaps the red eared sun fish, will attain to the greatest size, and is rather the handsomest fish. They are all rather small, but large enough for what are termed "*Pan Fish*:" rarely weighing over half a pound: they are however a fair flavored fish and well adapted to introduce into artificial ponds, being strictly a pond fish.

This fish together with the Grass Bass, and yellow Perch, might all be put together in the

same pond, as their habits and wants are precisely the same. It spawns in the month of May seeking shoal water, with a gravelly bottom.

The treatment of the eggs and young fish may be the same as in the preceding fish.

It is a greedy biter, affording great sport to lady and juvenile anglers, and prefers the common angle worm to any other kind of bait.



CHAPTER XVIII.

ANGUILLA AUCTORUM—EEL.

THIS most singular fish is deemed by most persons who have eaten it, as one of the very best for the table.

It belongs to the soft finned fish, and has no ventral fins, the dorsal, caudal and anal, being one continuous fin; its body is long and slender without scales: has no gill covers, but simply openings which are small and lie a little below the insertion of the pectoral fins. Its color is brown or greenish brown above, fading into a dirty white below.

Its size varies from a few ounces to several

pounds. Its skin is remarkably tough and strong, and should be removed before cooking the fish,

It has a general distribution in the northern, eastern, and southern States. I have seen a few taken in the tributaries of the Ohio river, though I believe them to be of a different species from the former. One was caught last year in the Cuyahoga river, which had undoubtedly found its way from Lake Ontario by the Welland Canal, and it will not be surprising if in the course of time they should become quite plenty in the upper lakes and their tributaries. In the months of August and September I am told they are very abundant at the Niagara Falls, crawling over the wet stones in the spray of the falling water, where they can be easily taken in great numbers.

They are very tenacious of life, and will live several hours out of water, and can be transported great distances, by placing them in wet grass; this mode would probably be the best way of transporting them alive.

I am not informed as to their time or habits in spawning. They are very prolific however, and are well suited for culture, thriving well either in still or running water.

It readily bites the common angle worm, which is perhaps the best bait for capturing it, and may be taken either in the night or day time.

This closes the list of what I deem the most suitable fish for cultivation, although there are some others, which may be considered by some persons as worthy a place in such a work, among which might be ranked the different species of *Pimelodus* or cat-fish, and perhaps some others, but enough has been said in the preceding chapters to guide any one wishing to make experiments with other kinds of fish, than those described.

I have also omitted many kinds of valuable fish, such as the Salmon, the White-fish, the Shad, and many others; for the reason, that strictly speaking they are not suited to what may be termed *domestic* culture.

Should this little volume meet with the approval of the public, I intend to publish a second edition, which shall embrace all the valuable kinds of fish in the United States, with illustrations taken from Photographic drawings, and otherwise handsomely embellished with views of some of our most picturesque scenery, also containing statistics of our important fisheries showing the extent of their deterioration, and the remedy.

Any information relating to our fisheries, such as statistics of their products in different years, embracing as long a period of time as possible,

showing their increase or decrease &c., or any other information relating to the subjects embraced in this work will be thankfully received and due credit given.

CONCLUSION.

GENTLE reader we have now brought our little volume nearly to a close. I most sincerely wish it had been undertaken by a more able pen, and my apology for such an undertaking is that I have been solicited by persons from every part of our country for information on the subject of fish-culture. In fact the letters received became so numerous that it was quite a tax on my time to answer them, and I concluded the cheapest way to get out of the difficulty would be to write this little work.

My experiments for the last three years have been so satisfactory, that I can with great confidence recommend any one having suitable waters, to engage to some extent at least in this interesting branch of human industry. Dr. Ackley and myself have at the present time, a large number of young trout which have hatched this season, and all are doing well. We exhibited at the State Fair held in this city last fall, nearly one hundred live trout, from six years old, down to the little troutlet, and all from three years old and under were bred by artificial impregnation.

For the purpose of removing doubts with the skeptical, I here insert a notice of our exhibition by a visitor of the Fair Grounds, also a notice of our fish ponds and nursery by the talented and gentlemanly editor of the *Louisville Courier*.

THE TROUT.

“ONE of the most interesting novelties on the Fair ground, was a glass reservoir, containing a number of young trout, artificially reared by Dr. Garlick. The Doctor himself was there, apparently much satisfied with his pets, and explaining the process of rearing them to those who had not been so fortunate as to read his communications in the *Ohio Farmer*. The scaly strangers were really beautiful creatures, sparkling, and changing their hues with every motion of their graceful bodies, leaping, diving, and chasing each other in the very spirit of frolic. Some had attained the respectable age of three years; others were mere flakes of gold and silver, darting about like minnows, yet I saw no indications of a cannibal nature on the part of the largest. Perhaps, after all, “big fishes” do not *always* eat “little ones!”

Dr. G. has given complete proof of his success in the branch of science to which he is devoted, and deserves the thanks of the community, not only for the instruction, but the gratification afforded by this interesting spectacle.”

A VISITOR.

“The artificial reproduction and cultivation of fish, have for some time been practiced in some parts of Europe. In France it is now carried on to considerable extent, and the produce of some of the streams and ponds yields large profits. The subject is now attracting some attention in the United States. The New York State Agricultural Society, in their last premium list, have offered a prize of \$100 for the best essay on the *Production and Preservation of Domestic Fish for Ponds*.

Drs. Garlick and Ackley, known as distinguished surgeons of Cleveland Ohio, were the first, we believe, to introduce the artificial spawning and domestication of fish in the United States. Dr. Garlick being an enthusiastic amateur in this line commenced the business in connection with his associate Dr. Ackley upon the farm of the latter two or three years ago. They made several trips to Lake Superior and Port Stanley in Canada, to procure trout for stocking their streams and in every instance were successful except the first, when they lost a large number of fish in transportation. After this, with personal attention they found that by reducing the temperature of the water in the vessels containing the fish to 32 degrees by the application of ice, the respiration and circulation in the fish was so reduced that they experienced no difficulty in transporting them any distance with perfect success. In this way they have procured at different times 150 full grown trout. Feeling an interest in the

success of this enterprize, and while visiting Cleveland a short time since, we called on Drs. Ackley and Garlick who very kindly conveyed us to the farm and fish nursery, situated about three miles from the city. The farm contains 100 acres, through the timbered portion of it, runs a ravine abundantly supplied with never failing springs of water. Across this ravine, dams have been built so as to form three ponds, connected by sluice-ways between them. In the upper pond the young trout are confined by netting across the sluice. The second pond designed for the fish two years old, and the lower one for the fish after they become so large as to be able to protect themselves from the voracious appetite of the older fish of their race.

At the head of a large spring and near the upper pond is situated the hatching house. In this house is a tank four feet wide by eight feet long, two feet deep. The water is received from the spring into this tank, and is discharged from a pipe near the top into the hatching boxes, ten in number, and so arranged that the first is higher in the series than the last, so that there is a constant stream of water passing from the tank above through the ten hatching boxes. In this tank we saw the *old pet* fish "*Naiad Queen*," the prolific mother of thousands. Her mate "*Triton*," like those of his sex sometimes in other departments of animated nature, had become somewhat unruly, and had been assigned his abode, for the time being, in one of the ponds with the

family at large. Our friends have so educated and trained the old queen, that she has become as tame as a tame chicken, and eat minnows from our fingers readily. This fish was taken from the tank and placed in a pan for our inspection. She is like all this family, truly beautiful. She measures about seventeen inches in length. Her weight we now forget, but with careful feeding can be increased with astonishing rapidity. We were presented by the gentlemanly proprietors with a most beautiful engraving of her.

It is the intention of these gentlemen to have some of the old and a number of the young fish on exhibition at the Ohio State Fair the coming fall. The display of domesticated Salmon and Trout, it is said, constituted a most interesting feature at the great National exhibition recently closed in France.

Dr. Garlick is now engaged in writing a series of articles on the "Artificial Reproduction of Fish," which appears in the *Ohio Farmer*. They will be finally published in book form, and will no doubt prove of immense value to farmers and others who own streams and ponds in this country.

In every State in the Union, and in almost every county, there are numerous springs and streams that with comparatively little labor may be turned to profitable account for the production of fish. Where brisk, cool springs are not to be found suited for trout, ponds exist adapted to various kinds of fish that delight in still

water. In a day's ride through some sections of the country, we have frequently met with a dozen springs and streams that might be profitably employed in this way. In France and other countries of Europe, not only trout and many kinds of still water fish are propagated to a great extent, but Salmon by thousands are reared to full size in a very short time. In the northern and eastern sections of our country, but more particularly near the Northern Pacific coasts, numerous places abound, most admirably adapted to Salmon. It is said that a thousand pounds of fish in proper places can be produced at a tithe of the cost of raising an equal quantity of meat." *Louisville Courier.*

Wishing the reader much pleasure every way, but more particularly in his experiments in Pisciculture, I bid him a kind farewell.

CLEVELAND, OHIO, Jan. 20th, 1857.

APPENDIX.

I append the following review of Dr. Bachman's paper, principally for the purpose of guarding persons from making experiments in that loose and uncertain manner detailed in the Dr's. paper. However well it may have succeeded with him. I am sure it would fail with me in every instance.

REVIEW OF DR. BACHMAN'S EXPERIMENTS.

LURLIE BERG, near Cleveland. }
March 10th, 1856. }

EDITOR OHIO FARMER—*Dear Sir:* In looking over the January No., of the *Southern Cultivator*, I find that the editor claims for the Rev. JOHN BACHMAN, D. D. of Charleston, S. C., the credit of successfully breeding fish, from artificially impregnated eggs, more than half a century ago. The editor draws his conclusions from a paper read by Dr. Bachman, before the State Agricultural Society, of South Carolina, at Columbia, in 1855. In an editorial note, he calls my attention to Dr. Bachman's experiments, for the purpose of correcting an erroneous impression that he

supposed I was laboring under, in believing that I was the first, in this country, to breed fish from artificially impregnated eggs, and desired an early response.

The reason why I did not reply at an earlier period, is that I did not see the December and January No's., of the *Cultivator*, until to day, and shall therefore, for the present, confine myself to a few brief strictures, on Dr. Bachman's paper. It matters but little who was the first in this country, to breed fish artificially, and I am not disposed to have a controversy with any person, be he clergyman or layman, for all the credit there is in being the first successful experimenter, in artificial fish culture, in this country.

I may, however, be permitted with a good many others, to express my surprise, that Dr. Bachman's experiments and discoveries, never found their way before the public, until after the lapse of full half a century after they were made. I trust, I shall be pardoned for saying, that I have very little confidence in the genuineness of all claims for discoveries, made over a half a century since, and for the first time given to the public last fall, particularly when they are of such vast importance as Dr. Bachman claims this to be, and it is very strange, that it did not appear to be of more consequence to the

Dr. until after some one else had made the same experiments over fifty years afterwards, and given them to the public.

I have read Dr. Bachman's paper carefully, and I am astonished at very many of his statements. The Dr. made his first experiments in 1804, when a school boy, and at the time, did not know that any book had been written on fish, and succeeded in hatching five or six thousand young fish, from the ova of some fish known as the 'Corporal,' the parent fish *having been dead several hours*. With a commendable zeal, and an ardor, rarely met with, except in youthful minds, he made his next essay upon the *Salmo Fontinalis*, brook trout, and here his success was more marvelous, than with his Corporal, for he succeeded in vitalizing their ova, *at least one month before they were mature*. We will give the Dr's. own words for the benefit of those who may not have had the pleasure of reading his essay.

'A cold spring, used for drinking purposes, poured its stream from the sides of an adjacent hill, at the distance of about an hundred yards. This we conducted to the pond in zig zag lines by which the distance was increased. By dint of digging, we formed shelving banks, and damming up the stream in some twenty places with rocks, we were provided with so many ponds of

from 6 inches to 2 or 3 feet deep. The water was very clear, and, after filling the ponds, it ran with a gentle murmur from one little pool to the other, until it finally entered into the pond. It was late in summer before the work was completed. A single day was only left us in our school vacation, the following day being the first of September, we had to leave for an Academy in a neighboring State. We determined, if possible, to stock our stream with Trout on that day. Our servant had to pass through the woods to the Trout brook, and carried no other vessels but two tin kettles. He was very successful in taking with a hook, about twenty large Trout; but he had been too greedy for numbers. The day was warm, and, notwithstanding his having changed the water several times, the Trout were all dead. The females were full of eggs, ready to be deposited, all the true Trout family spawning in autumn instead of the spring. We again resorted to the spawn, and at this time, with more than a faint hope of success. We separated the eggs and placed them together with the milt, in all the different holes of the newly formed Trout brook, giving strict orders, that the eggs and their young, during our nine months absence, should remain undisturbed. We expected the eggs to hatch in a

month, as had been the case with our Corporals. We heard weekly from home, but were always informed that our present experiment had proved a failure. The winter came with its snows, forming ice in our pond two and a half feet thick; but our cold trout stream was scarcely ever frozen over to the thickness of half an inch. On the following April, however, we received the agreeable intelligence, that many hundreds of our young Trout had made their appearance, and were swarming in every trout hole in the stream. We had a trout breakfast from our brook, greeting us on the day of our return, on the following autumn. The fish were not large, but, for their age, well grown and delicious.'

Again, we have young fish hatched from the ova of *dead* fishes, and that too, at least one month prior to their maturity, the eggs being obtained on the last day of August. I desire the reader to bear in mind, that no fishes eggs, can by any possible known means, be impregnated or vitalized, until they are mature, and this is never the case, until the parent fish are engaged in depositing their eggs.

I am well acquainted with the habits of the brook trout, and have been from my boyhood, and for the last three spawning seasons, have artificially spawned and impregnated the eggs, from

a great number of trout, and can, therefore, speak with a certainty, as to their time of spawning. I have never known the brook trout, even to *commence* making their spawning beds in the month of September. In the early part of October, a few only, commence spawning; by the middle of the month, a majority are through, and begin to leave the beds; there will, however, be trout running up for the purpose of spawning, until in November, and I have spawned them, as late as the twentieth of that month.

Admitting the parent fish were on their spawning beds, when taken by the Dr.'s servant, it is no less a mystery to me, how he took them with a hook; with the little skill I possess, as an angler, I never could induce a trout to take any kind of bait, while engaged in spawning; and the best anglers I have ever seen, tell me the same; but perhaps, if we had sent our servant, we might have got *twenty*, or more.

But let us pass on. In the following autumn, the Dr. returns from the academy, and on the day of his return, is greeted with a breakfast of the young fry. He says they were not large, but well grown for their age, and delicious. Gentle reader, do not call this a fish story, for I will not, but I will say, if the lad

was even a tolerable feeder, and most school boys are apt to be, he must have devoured at least *two hundred trout* at that breakfast. I think, Mr. Editor, you must distinctly remember the size of trout at that age, as you saw those we exhibited at our County Fair, one year ago last fall, but as all your readers may not know the size of trout at that age, I will give their dimensions: the *largest* ones are about *two and a half inches long*; their circumference a little over that of a common sized goose quill.

The Dr.'s experiments did not end with his breakfast. In 1806, he procured some of the spawn of the yellow perch, and after *drying them for ten days*, he placed them in water, the product of which was a considerable number of young fish, the Dr. has not told us for what purpose he dried the eggs, and then hatched them, but I suppose he was endeavoring to hit upon some method of transporting them, from one part of the country to another, for the benefit of those who might wish to engage in fish culture; but unfortunately, he never made this interesting experiment known for half a century.

I will close, by assuring such of your readers, as may wish to engage in fish culture, they must pursue a course widely different from Dr.

Bachman's experiments, or certain failure will be the result.

Wishing the Doctor great joy with his *hard* won laurels, for the present, I bid him adieu.

THEODATUS GARLICK.

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