XXII.—PAPERS RELATING TO PRACTICAL FISH-CULTURE.

A.—METHOD OF TREATING ADHESIVE EGGS OF CERTAIN FISHES, ESPECIALLY OF THE CYPRINIDÆ, IN ARTIFICIAL PROPAGATION.

By Rudolph Hessel.

[Translation.]

Offenburg, Germany, *May* 3, 1872.

In giving the following instruction for hatching the eggs deposited by certain fish in the summer-time, I thought it best to select the species of *Cyprinidæ*, with adhering eggs, for my communication. Such eggs are of larger size compared with those of the other *Cyprinidæ*, and thus the manipulation of impregnation and the observation of the progressing changes are much facilitated. Besides this, it is a fish of great value for table-use and for feeding other fish, and is, in all probability, (though I do not know with certainty,) already introduced into your country, so that you will have no difficulty in procuring male and female specimens for your hatching experiments.

The carp have adhering eggs, and with reference to this peculiarity, the mode of impregnating and the arrangement of my hatching-apparatus are based.

I presume if you cannot obtain any carp, other *Cyprinidæ* with adhering eggs might be substituted; even the percoid *Perca fluviatilis*, (Linné,) which has adhering eggs, would do, as my apparatus is adapted for any fishes of this habit.

I can highly recommend the *modus operandi*, as it has been fully tested by many experiments, provided that your water has similar constituents, is free from contamination by industrial establishments, is of moderately elevated temperature, and, especially, is not infested with spores of the confervoid, (*Leptomitris clavatus.*) With some care, you will have favorable results, but my directions must be strictly followed. You are fully acquainted with the *Cyprinus carpio* and its habitat, and therefore I need not detail my observations made in different parts of Europe during the last twenty years, beyond remarking that it occurs in many of the larger rivers of Middle Europe—the Rhine, Vistula, Elbe, Danube, &c.—and in many lakes. It is especially adapted for ponds, and most of the German villages and estates have ponds where both carp and pike occur together, their propagation being left to nature. It is remarkable that carp thrive equally well in sea-water even attaining better quality and larger size than in fresh. I have fre

quently known this fish to reach the weight of thirty pounds in German lakes and ponds. In Germany, carp are often confounded with hybrids of *Cyprinus carassius*, (*Cyprinus kollarii*, Heckel,) or of *Cyprinus abramis*. Their quality, however, is much inferior to that of the genuine carp.

In middle Europe, carp deposit their eggs in the first summer-days—from the beginning of May to the end of June. In the south, the fish attains a larger size; that is, it grows faster in the same time, since, in northern countries, it is naturally forced into a longer winter-rest. In spring-water it does not thrive at all, requiring warm water in summer-time, with mud at the bottom, and for nourishment, the lower forms of life, (microscopic animal organisms, worms, snails, remnants of plants, &c.)

The eggs are deposited upon water-plants—not those nearest to the surface and exposed to the direct hot sun, but such stems of these *water-plants as are about one inch below*, to which the eggs, when extruded, adhere. Those falling off either perish in the mud or are destroyed by numerous enemies. This peculiarity of adhesion in the eggs, and the usual position of the stems which serve as their depository, suggested the arrangement of my apparatus. This very simple contrivance consists of a number of light, wooden, rectangular frames, about three feet long and one broad, covered on one side with thin gauze or mosquito-netting, (Pl. XVIII, fig. 3.) Upon these screens the impregnated eggs are spread and immediately adhere. After impregnation, (for which directions are given below,) the frames are placed in a floating box, (Pl. XVIII, fig. 1,) the sides of which are covered with some kind of canvas, but somewhat more open than that of the frames, in order to allow a more rapid change of the water, while preventing the escape of the young fish.

The bottom and cover of this box are made of canvas, each box having room for three frames; each frame having on its two sides 20,000 eggs, so that the whole box contains 60,000 eggs. The stuff for covering the frames, &c., must be soaked for some days in river-water, and the size and coloring-matter carefully removed by washing; no soap, however, should be used.

THE IMPREGNATION.

It is, of course, necessary that the fish selected for impregnation should be in a fit condition; the eggs and milt being neither unripe nor overripe, since overripe eggs do not receive the zoosperms well, and overripe milt proves inactive even upon good eggs, its vitality being nearly lost from partial decomposition. If the eggs and milt are immature, so as to require considerable force to express them, no success can be expected. It is always advisable to keep ripe fishes confined in running water for several days previous to the impregnation of the egg.

For the operation itself two persons are required: one, the operator

proper; the other, an assistant. The first frame, which, like all the others, has to be again well-cleaned, is placed in a shallow vessel or dish of tin. (Pl. XVIII, fig. 4.) These vessels are to be made expressly for the purpose; two of them being necessary for the operation. Their size is somewhat larger than that of the frames, to facilitate the manipulation; their height, however, must never exceed two inches. These plates have to be carefully cleaned to remove all fatty matter and oxide of tin. Into one of them the eggs are emptied; in the other the impregnation is performed.

The dish is nearly filled with river-water, like that in which the hatching is to take place, of from 72° to 82° F.; its temperature shall be 18° to 22° R., (72° to 81°.5 F.) Then the frame is placed upon the water, and the eggs slowly dropped upon it. The fish is moved back and forward just above the frame, so as to prevent too much crowding of the eggs. As soon as the eggs adhere, the frame is reversed, and the other side treated in the same way. After ten to twenty seconds, this frame, evenly covered with eggs, is removed to the other dish, containing about one inch of water; the milt is then added, or may have been added while the second side was receiving the eggs. Yet there must not be too long an interval between the operations, since the life of the zoosperms of these *Cyprinidæ* is frequently of very short duration. In carp it is scarcely two minutes. The second frame is treated in the same way, while the assistant carries the first to the hatching-box, which ought to be, if possible, at the very place where it is to remain. A repeated addition of fresh zoosperms to the impregnation-dish is advisable. In the same manner, all three frames, with impregnated eggs on both sides, are placed in the hatching-box. The outer frame of this box must be stout enough to keep the perpendicular frames well in place, so that they can neither warp nor fall down. The box must be set where the stream does not exceed twelve inches in depth, with a scarcely perceptible current. One inch a minute is the greatest allowable velocity, just enough to carry fresh water and air. But the apparatus can also be used in stagnant water. The canvas cover is only laid upon the box when the heat of the sun is most intense—perhaps from noon to 4 p. m.—for too much sun is just as injurious to the development of the eggs as darkness.

Every day the apparatus must be inspected and dead or sterile eggs removed. Pincers of wire, about three inches long, and which may be made by one's self, are convenient for the purpose. After three weeks, the eggs will be hatched, and the young fish may be removed to ponds or lakes, wherever wanted. The hatching, in the same manner, can be done in ponds.

Still another mode of breeding is in use here as well as in North Germany and on the Danube. Employing no frames, it is cheaper, yet less convenient for an observer, as the eggs mostly remain hidden and invisible. It has, however, the advantage of simplicity, and thus may be applied

in remote and solitary localities without carrying along previously-prepared apparatus. Pl. XVIII, fig. 5, is a frame made of saplings one to two inches in diameter, such as can be found anywhere in the woods. The several parts are either tied with willow-twigs or roughly nailed together. This frame is made four to five feet long, three feet wide, and one high. It is densely interwoven with juniper or fir brush, while the upper side is left open, and has the appearance of a box or basket of brush. Common or Virginian juniper is most suitable for the purpose, for the inside must not in any way be trimmed—the rougher the better; even some juniper-branches may be laid inside, their rough prickles, indeed, appearing to promote propagation. I have often observed that fishes in smooth willow-baskets, with leaves in, remain lazy and inactive, while others in prickly juniper-boxes were progressing industriously in their work. This basket (Pl. XVIII, fig. 6) is to be set in a warm and sheltered place with two female and one male fish in it. A piece of netting is tied over the top to prevent their escape. The process of breeding is left entirely to nature. In these plaited boxes, *Cyprinidæ* without adhering eggs may also be hatched, when the bottom is dense enough to prevent the eggs from falling through. (To the hatching of *Cyprinidæ* with non adherent eggs, I have referred in a former letter.)

I have thus explained two methods, in accordance with your wish. You will do well to practice both. Mine I have frequently tried and never found wanting. You must, however, not get discouraged in case of failure. Some little mistake or oversight may mar the success. I may as well tell you that at first I failed five or six times, and now my results are always favorable.

The hatching-box must be placed in the water so that the top projects about one-fourth inch above it. Dead eggs have to be removed promptly. After the young fish have absorbed the yolk-bag, they may be left for some days in the hatching-box; but afterward must be fed with mashed brains of cattle, &c., and removed to ponds, &c.

The hatching-apparatus, when in the water, must not touch the bottom, but ought to remain several inches from it. The cover ought always to be one-fourth to one inch above the water. In shallow water, hatching-boxes and frames have to be reduced in height to correspond with the depth.

For operations on a smaller scale, boxes twenty to twenty-five inches long and four inches high are well adapted for hatching *Cyprinidæ* with non-adhering eggs. These should have a solid bottom board, covered with fine, washed sand, and supported by strong floats. They, of course, need no perpendicular frames, as the eggs are deposited upon the sand, neither is any shading required, however burning the sun may be.

B—ON THE SO-CALLED "DRY" METHOD OF IMPREGNATING SPAWN.

From Circular No. 3, 1874, published by the German Deutsche Fischerei-Verein, Berlin, June 22, 1874.

[Translation.]

Following a suggestion made in Circular No. 1, 1874, I have the honor to lay before the public the results of a method of dry impregnation practiced by me since 1857, which, if properly carried out, is sure to be successful.

As I have not read the articles on the subject contained in Circular No. 4, 1871, and in Circular No. 6, 1873, I am not able to say whether the "Russian dry method" recommended by Livingston Stone is similar to mine; the term "dry method," however, makes a similarity of both methods very probable.

In the autumn of 1854, I established at Wernersdorf, district of Balkenhayn, province of Silesia, some trout-ponds, and it was my first care to provide some cheap living food for the young trout placed in these ponds in the spring of 1855 and 1856. For this purpose, I had made, close to one of the ponds, a spawning-basin with flat shores and separated from the pond by a railing. In this basin, I placed some carp, the young of which could through the railing escape into the pond.

As there were older trout in the other ponds, I likewise endeavored to raise young fish for these, and selected the "nase," which spawns in large numbers in the river Bober in April, and is in those parts commonly called "zupe," (*Chondrostona nasus*, Sieb., *Cyprinus nasus*, Lin. and Bloch.) These fish spawn in large numbers in the shallow stony places in the middle of the bed of the river Bober, places over which the water flowed rapidly and producing considerable waves.

In April, 1856, I placed a large quantity of the roe of this fish—which is easily extracted—in flat vessels filled with Bober water, and after a brief interval I poured in the ripe milt, stirring it with a quill-pen. This method of impregnation differed in no respect from the one I had always successfully employed with trout-spawn. The result of this artificial impregnation, however, was an entire failure.

The eggs, after having been placed in the water, swelled very rapidly on account of the sticky layer surrounding them, so that no impregnation could take place.

Although I noticed this rapid swelling of the eggs, and their considerable stickiness, as after a short while they stuck so firmly to the bottom of the vessel that it could be placed upside down without their falling out, I did not find out the cause of this failure till I saw that there was no normal development of the impregnated eggs, but that they were entirely spoiled.

I determined at my next attempt to pour the milt in immediately, and

thought that by doing this very rapidly I might insure success. The spawning-season of the "nase" for 1856, however, was over, and I had to defer my experiments till April, 1857. In that month the "nase" spawned in exceptionably large numbers and several times; I consequently had an opportunity of watching them closely during the spawning-process, and the observations I then made led me into the right path.

Very frequently two fish would leap close together from the water, which led me to suppose that during this violent motion the spawn which sits very loosely in the body of the fish, and the milt which flows off very easily, might be dropped in the air, and that the eggs might possibly be impregnated by the milt before they touched the water.

Although I, of course, could not observe the very act of impregnation—which, as I supposed, took place—during the very short time occupied by the leap of the fish, it became almost a certainty to my mind when I took into consideration the exceedingly violent motion of the fish and the extreme ease with which both the milt and the roe are emitted.

I was led to make further observations, proving the fact that fresh spawn when brought into contact with water swells very rapidly and sticks to any objects that present themselves, by seeing several tame ducks devour very eagerly the spawn found on the stony bottom. When taking up some of the stones, I chiefly found their lower surface thickly covered with spawn.

I must here remark that the strong current in these spawning-places indirectly contributes to the better protection of the spawn by driving it below the stones. If the spawning took place in gently-flowing water, the eggs would stick to the upper surface of the stones, and be exposed to many enemies.

I now made experiments with four different methods of impregnation, using only entirely healthy and mature fish, of which I could easily procure a large number. These fish were caught while spawning, and on the spot experimented upon.

1. I again used the "wet" method of last year, with this difference, however, that *immediately* after having squeezed the roe out of the fish, the milt was stirred in. This was done as rapidly as possible; at any rate, much quicker than the year before.

2. Assisted by a man, I poured into a flat vessel, filled with Bober water, milt and roe *at the same time*, stirring the water immediately.

3. Into a flat vessel containing but little water, I poured *first the milt*, so that after stirring the water immediately, it had a whitish color; then without delay I poured the roe into this mixture.

4. A fish containing roe was dried carefully and rapidly with a cloth, (occasionally, also, with the hands,) and the "*dry*" roe placed in a flat vessel containing no water. Over this was placed the milt of a fish, (that had likewise been dried beforehand with a cloth,) so as to cover the largest possible number of eggs. As soon as this was done, water was

poured over the whole mixture, and the whole was stirred immediately. The pouring-over of the water and the stirring was, if possible, done simultaneously, almost suddenly.*

The result of experiment No. 1 was a failure.

Of Nos. 2 and 3, only a few eggs out of several thousands developed, so that these two methods must likewise be considered failures.

In No 4, all the eggs were regularly developed with but very few exceptions. This method must therefore in every way be considered a success. It was proved conclusively that ripe eggs fresh from the fish when brought into contact with water immediately swell to such a degree that the sticky layer surrounding the eggs prevents the spermatozoa from entering the interior of the egg, impregnation thus becoming impossible. It is likewise proved almost to a certainty that during the natural spawning-process of the "nase," the milt touches the roe outside of the water, and that the water completes the begun process of impregnation.

This may therefore well be called *nature's own method of dry impregnation.*

I have at the same time, with many other comparative experiments, very frequently employed this "dry" method, especially with salmon-trout, and have in all cases been successful.

To insure complete success, the following rules and precautions must be observed:

1. The vessel used should be as flat as possible, and should, by rubbing it with a cloth, be completely freed from any dripping water; the inside of the vessel may remain a little damp.

2. As the temperature of the air but rarely corresponds with the temperature of the water, the vessel should externally, for some time, be brought into contact with the water to be used for spawning. This should be done so long before pouring in the roe as the length of time required for equalizing the temperature throughout the whole body of the vessel. If the difference between the temperature of the air and the water is not very great, neglecting this precaution will not prove injurious. It should, however, never be neglected when these temperatures differ greatly, or when the temperature of the air is below 0°, (Réaumur.) The vessels should not be taken out of the water before the end of the above-mentioned period.

3. Place in readiness both the fish, the one containing the roe and the one containing the milt.

4. First carefully dry with a cloth the fish containing the roe, avoiding the slightest pressure, so as to prevent the premature emission of the loose spawn; hold the fish in a horizontal position, and dry your

* The claim made on pages 541–543, for the discovery of a literally dry method of impregnation by American fish culturists, will have to be abandoned in favor of European specialists. It will be seen by reference to pp. 515 and 577 that Dr. Vouga, of Switzerland, and Professor Rusch, of Norway, have adopted similar methods.

hands carefully so that water could nowhere gather. Then pour the roe in a "dry" state on the bottom of the vessel.

5. If the drying-process has been well done, so that no swelling of the eggs can take place, take up without any too great hurry the fish containing the milt, dry it like the other one, and pour the milt over the eggs so as to cover the largest possible number. A quantity of milt which only gives the water—to be poured in afterward—a slightly whitish color is sufficient. The pouring over of the milt should be done quickly. With fish of the species of *Salmo* and *Trutta* a quarter of an hour may intervene between putting the roe in the vessel and pouring in the milt, provided all the other conditions are favorable.

6. As soon as the milt has been poured in, pour over the water as quickly and as suddenly as possible, so as just to cover the eggs with water, and stir the mixture with the hand, letting it rapidly describe a circular motion on the bottom of the vessel.

7. Let the whole stand for a while, this period of standing to be regulated by the degree of stickiness of the roe and its power of swelling; sometimes amounting to less than a minute, sometimes to more than an hour. The impregnation commences in a short time, and it is therefore advisable to clear the milky water after a few minutes by pouring in clear water. The object of this period of standing is to diminish the sticking capacity of the eggs, which is strongest in the beginning, but which constantly decreases; also to insure in some species of eggs their complete development to the quickly-increasing spherical form, to make them gradually grow harder before placing them in the transporting-vessels, and thus to prevent their pressing each other too much.

8. Before placing the impregnated roe in the transporting-vessels, loosen it carefully with a quill-pen from the watery bottom of the first vessel.

9. Never fail to select vessels of considerable size for such species of roe as swell rapidly, so that the eggs can lie loosely without pressing on each other. All vessels used for this purpose should therefore have a flat bottom.

Whenever the milt is scarce, it may be recommended to use smaller vessels, so as to concentrate it as much as possible. Whenever this is done, it will be well, after having stirred the roe and milt with water, to pour it into a larger vessel with some water, and let it stand in this.

If this is neglected, the eggs will frequently be exposed to too great a pressure. Such eggs as do not contain the necessary space for developing the young fish will produce weak or deformed fish. With roe of the species of *Salmo* and *Trutta* this precaution is unnecessary, as well as with all those species of eggs which do not change their shape when exposed to pressure.

To employ the "dry method of impregnation" in *all cases* is not advisable, as the "moist" method is simpler, and in most cases proves successful.

The "dry" method, however, must *absolutely* be employed with all those

species of roe which swell *immediately* when brought into contact with water, thus preventing the entering of the spermatozaa, and under all circumstances it is a method which can be highly recommended:

1. When operating on species of roe which does not swell rapidly, and when loss of time between pouring in the milt and the roe, endangers success. With the roe of the *Coregonus* this loss of time is but very brief; with that of the species of *Salmo* and *Trutta*, in employing the "moist" method, about five minutes.

2. When you have only one fish containing milt for several containing roe, or whenever the quantity of milt is small.

3. Whenever roe is to be impregnated whose nature, when brought into contact with water, is not well known.

Every pisciculturist has, no doubt, often made the experiences mentioned under Nos. 1 and 2. The case mentioned under No. 3 came under my personal notice on the 25th of November, 1869, while artificially impregnating the roe of the *Coregonus maræna*. The nature of this roe was, at the time, new to me. As a precaution, I employed the "*dry*" *method*, which under *all circumstances is more certain of success*, in the presence of the royal superintendent of fisheries, Mr. Jeserich, and other gentlemen. *Every one of the eggs* operated upon was developed successfully.* In the year 1872, during the month of November, I repeatedly succeeded, by the "dry" method, in impregnating the roe of *Coregonus Wartmannii* in Lake Puls, in the district of Soldin, province of Brandenburg, because of the circumstances mentioned under Nos. 1 and 2. The eggs impregnated in this manner developed regularly and very successfully.

After all my experiences in employing the "dry" method, I can vouch for its successful results, provided the above-mentioned precautions are taken.

If this method is not successful, the failure must be ascribed, not to the method itself, but to other circumstances.

TANKOW, *April* 6, 1874.

ALEXANDER STENZEL,
Inspector of Fisheries.

C—FISH-CULTURE IN SALT OR BRACKISH WATER.

BY THEODORE LYMAN, *Fish-Commissioner of Massachusetts.*

When shores are not bold, and have extensive shallows, there is often a considerable zone of sea which produces few valuable fishes, although swarming with fry and with small crustacea and mollusca. In Norway

* As the piscicultural establishment at Tankow was not commenced till the middle of November, 1869, there was a lack of suitable water for receiving the roe of *Coregonus maræna*. In the beginning, it developed regularly, but was soon spoiled by the impurities of the water and its low temperature. Some eggs placed in purer water, with a higher temperature, developed fish which reached the age of three weeks. During this spring, (1874,) the *Coregonus maræna* has been raised successfully.

attempts have been made to use portions of such shallows for the raising of marketable species.

It is well known that the growth of the trout, as a genus, is peculiarly affected by large supplies of food in salt-water. Thus, the salmon-smolt, which goes to the sea weighing a few ounces, returns as a grilse of three or four pounds. Our brook-trout, so long as it is confined to the meager insect diet of a shallow mountain-rill, scarcely grows beyond the size of one's finger; but, with access to salt-water in late winter and in spring, it takes on a silver coat, and with surprising rapidity attains a weight of one or two pounds.

The experiments of Professor Rasch have shown that these desirable results may be attained without allowing the fish to wander in the open sea. It suffices to inclose a space of brackish or salt water, and to keep the trout within those limits. There are two essentials: (1.) A brook emptying into salt-water. (2.) A narrow cove, inlet, or fiord making the continuation or mouth of such brook. If this inlet has a pinched place in it, so much the better, because there will be the economical spot to throw across a dam, or a grating, to bar the passage to the open sea. Usually some form of dam is desirable, so that when the tide ebbs, a certain depth of water shall be held back in the salt-pond thus formed. The barrier should not be of uniform height, because then the pond, becoming quite stagnant on the bottom, would gradually fill with mud brought down by the brook. To obviate this, a vertical cut should be left open to keep up the bottom current, (Plate XIX, Fig. 1 *a*.) The width of this cut must be such as to discharge the flow of the brook; otherwise it would rise and pour over the whole of the dam-crest, and the fish would pass over also. Further, to provide against such an accident and to give free passage to the flowing and ebbing tide, an ample waste-way, lower, of course, than the dam-crest, must be built next to, and continuous with, the cut, (*b*.) As to the crest of the dam, it must be raised higher than the level of the highest tides. It must be built, of course, solid, and of such material and with such foundations as its situation demands. If, as often occurs, there is a stratum of salt-mud, the foundations must be built quite close, to prevent musk-rats from working through; for one hole is enough to let out the greater part of the fish. The waste-way should be of ample width not only to let out the water of the brook in case of a flood, but to freely admit the tide, which brings in food. It must be carefully grated, together with the cut, which is sunk lower. It requires some calculation so to arrange gratings that they will not get clogged with drift material. They must be arranged on the principle of coarser and finer sieves. On the pond side, and well out from the waste-way, the first grating may be put, with stout bars, five inches apart, (Figs. 2, 3, *c c*;) within this a second, with bars two inches apart, (Figs. 2, 3, *d d*;) after this, a central grating, which is the important one, intended to stop the fish, (Figs. 2, 3, *e e*.) It should be carefully made of one-quar-

ter-inch vertical rods placed, with one-half-inch gaps, in a hard-pine frame, and braced with horizontal wires, (Fig. 4, full size.) On the seaward side one screen, (Figs. 2, 3, *f*,) made like *d*, will be sufficient; and the stout screen *c* may be omitted where there is no fear of floating logs or branches. As the crest of the dam must be *higher* than the highest tide, so also the bottom of the waste-way must be *lower* than the lowest flood-tide, in order to insure the entrance of the sea-water at every flow. The changes of level produced by this dam will be understood through Fig. 5. The dark portion is a section of the old bottom, the marsh in the center and the upland rising on each side; the deep depression in the middle is the old bed of the brook. In its natural state, the brook, at low tide, would only fill its banks to the line A B; at high tide, the water would be backed up to the line E F. When the dam is built, the water, at low tide, would be as high as the line C D, because the deep cut *a* is narrower than the natural bed of the brook; at high tide the level would be the same as without a dam, namely, E F. The advantages gained are: first, that while a flow of water is still kept up, the depth and surface are much increased by raising the level; and, secondly, the fish, by means of the grated cut and waste-way, are prevented from wandering. A brackish pond thus made would have a brook (Fig. 6, G) running in at its upper end, where the water would be shallow and fresh, E; while at the lower end it would be deep and more or less salt, F; and the deeper the better, for this breeds big fish. The *Salmo lacustris* of Western Europe, and the great thirty-pound trout inhabiting the Norwegian lakes, some of which are three hundred fathoms deep, are considered by Professor Rasch as only overgrown individuals of the common European brook-trout, *Salmo fario*. Our own brook-trout, *Salmo fontinalis*, is known to attain to twelve pounds in our Maine lakes, where the water is deep and food plenty. In water brackish, or nearly salt, and crowded with crustacea and small-fry, the depth does not count for so much; and a trout will pass from one to two and from two to three pounds rapidly, although he may nowhere find holes more than five feet deep.

Two such ponds as have just been described were laid out by Professor Rasch in 1869; the one covering some seventy-five acres, at Sandvigen, near Christiania; the other of two hundred and seventy acres, and with a maximum depth of thirty-eight feet, not far from Frederickstad. The tide in the last ramifications of these Norwegian fiords is very slight, not exceeding one foot; so that a low and cheap dam is sufficient. In a rough slab shanty, twelve feet square, he hatched 80,000 salmon-eggs in one season. The apparatus inside was equally primitive; only a set of narrow board troughs, arranged step-fashion, and emptying into each other by notches cut in alternate ends. Some gravel was placed in the bottom of these troughs. A wooden pipe brought in the water from a neighboring spring. There were no filters, stop-cocks, or tanks.

Professor Rasch collects the eggs, *dry*, in a basin, which has simply

been sponged with water; then the milt is squeezed over them, and, finally, a small quantity of water is added, while the basin is tilted to and fro. If the egg be kept thus dry, the micropyle will remain open for several hours; but in water, the egg immediately begins to swell and the micropyle closes, shutting out the spermatozoa.*

As soon as the hatched fry had absorbed their yolk-sacs, they were turned loose in the brook, where they grew during the parr stage, feeding in the brook itself, or in the shallows of the upper pond. Taking on the smolt coat, they descended toward the lower end, seeking the salt-water, when, as ill luck would have it, they found a small hole, and the greater part escaped, some of them returning next spring to the foot of the dam. Enough, however, remained to show that the smolt will continue his growth when confined in a salt-water pond. Trout, which were raised beside the salmon, were more quiet and did not escape. They throve amazingly and grew to a great size.

The owner of an artificial brackish pond may either depend on the natural increase of the fish that were before in the brook, or he may add fresh material. If he depends on natural breeding, he will place adult fish in the brook where they will breed. Or he may have a hatching-house, which could be placed near the brook, and in which young fry could be raised to be set free in the shallowest portions of the water.

In a pond and brook of good extent, several species would doubtless do well, living side by side. Such species and varieties as the true salmon, the land-locked salmon, sea variety of the brook-trout, the Sebago salmon, and the forkep-tailed salmon-trout of the great lakes might profitably be cultivated. In addition to these, Professor Rasch recommends hybrids, which are never fertile, and which are therefore fat and in good condition during the breeding-season. Mr. Hanson, of Stavanger, on the west coast of Norway, has observed that a hybrid from the brook-trout (*Salmo fario*) and the charr (*S. umbla*) grows much faster than either of these species, because none of the flesh and fat producing materials are expended in developing the large organs of reproduction. Taking our brook-trout as one, the breeder might select the other fish from such as were at his command. Doubtless some near species, such as the togue of the Maine lakes, or the forked-tailed salmon-trout of the great lakes, would yield the surest impregnation.

D—DESCRIPTIONS OF IMPROVED APPARATUS IN FISH-HATCHING.

1.—SHAD-HATCHING OR FLOATING BOXES.

Seth Green's box.—The devices used in shad-hatching are, first and

* The dry method of impregnation has since been successfully tried by Mr. Atkins in breeding salmon.

most important, Seth Green's box,* (Pl. XVII, Figs. 1 & 2,) patented, which has been longer and much more extensively used than any other. It is an ordinary box, made of inch-boards, and covered on the bottom with wire-cloth painted with coal-tar or naphtha varnish, and with two cleats made of scantling nailed obliquely to the sides of the box, which act as floats; these incline the box so that it stands with the bottom presented toward the current at an angle of about 60° in an ordinary tide-current, creating a slight but sufficient circulation of the water in the box to keep the eggs from lying entirely inert at the bottom. Six or more boxes are tied together in a string or gang, and anchored a short distance from the shore.

Brackett's box.—Another box patented, used by Mr. Brackett for the first time in 1873, is arranged to float horizontally in the water; the end presented to the current sloping inward and backward, so that the bottom of the box is of less length than the top. A circulation is produced by the downward deflection of the current, which creates an eddy directly beneath the wire-cloth bottom of sufficient strength to agitate the water and the eggs within the box.

Stilwell and Atkins's box.—Another plan has been suggested by Mr. E. M. Stilwell, fish-commissioner of Maine, and Mr. Charles G. Atkins, of

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* *Device for hatching the spawn of fishes.*—United States Patent-Office.—Seth Green, of Rochester, New York.—Letters-patent No. 68871, dated September 17, 1867.

(The schedule referred to in these letters-patent and making part of the same.)

To all whom it may concern:

Be it known that I, Seth Green, of Rochester, in the county of Monroe, and State of New York, have invented a new and useful "method of hatching fish-spawn;" and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawing, making part of this specification in which the figure is a vertical central section of my invention, represented as applied in the water.

This invention relates more especially to the propagation of shad, and its nature consists in the peculiar construction and arrangement of a propagating or fish or frog-spawn hatching-chamber in such a manner as to effect a perfect and uniform circulation throughout the entire chamber, and at the same time prevent the escape of the spawn, and also of the young fish, until the attendant thinks proper.

To enable others to make and use my invention, I will describe its construction and operation.

I provide a rectangular box, A, of any desired size or proportion. I prefer them, however, about two feet long by eighteen inches wide and ten or twelve inches deep. I provide a suitable square opening in one end, as shown at B. This opening is covered upon the inside of the chamber with a fine wire screen, about No. 12, and upon the outside is hung a cap, C, which may be pivoted above, as shown, and made to swing down over the opening, or it may be made to slide over it horizontally. I also provide the open bottom with a similar wire screen, D, but of finer mesh. I attach a shallow frame, F, to the lower edge of the chamber or case A, outside of the screen. There may be one or more cross-bars, E, but they should be made thin on the upper side as shown, to prevent the lodgment of any of the spawn upon them, as the spawn will only hatch well when buoyed up in the water by a perfect circulation. I attach a float-bar, G, obliquely across each side of the case or chamber A, and to one end of these I attach a

the salmon-breeding establishment at Bucksport, as illustrated in the accompanying diagram and its explanation. (Plate XVII, Figs. 4 & 5.)

The drawing represents the box in the position it assumes floating in the stream; a portion of the nearest end removed to show the bottom. The left face is presented to the current, and the water enters in the direction represented by the arrow. Circulation is produced by the movement of the current up the inclined bottom, which carries the eggs with it, to fall back again in the recoil from the back of the box. When left entirely to itself, it floats in such a position that the bottom is at an angle with the surface of the stream, and this angle is to be in an opposite direction to the current from that of Seth Green's box, and can be increased to whatever extent desired by weighting the front of the box.

2.—TRAY-APPARATUS FOR HATCHING.

Holton's tray-hatching apparatus.—United States Patent-Office.—Marcellus G. Holton, of Rochester, N. Y., assignor of one-half his right to Seth Green, of same place.—Improvement in fish-spawn hatchers.—(Specification forming part of letters-patent No. 136834, dated March 18, 1873.)

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suitable anchoring-cord, *c*. They are connected together a few feet from the bars, and continued in one cord to the anchor *k*. The chambers may be cut down, as shown, or they may be left full, as indicated by the dotted lines *d*. The floats F may be very much lengthened, if desired, and a series of cases attached to them, or there may be a long case made and provided with suitable divisions and anchored across the stream, from each end, but I prefer to have the cases made separate, and in size and proportion about as first described. They should be arranged more or less obliquely upon the floats F, according to the rapidity with which the current runs in which they are to be anchored. The obliquity shown in the drawing I find well adapted to a current running about two miles per hour, for shad, which affords a perfect circulation, just sufficient to keep the shad-spawn perfectly buoyed in the water, and all exposed to a gentle agitation. In a faster stream or current, the case should be arranged flatter upon the floats, and *vice versa*.

The spawn to be hatched in this apparatus is prepared in the usual manner for artificial hatching. The cases should be carefully watched. They should be anchored in a current for shad, but may be anchored in still water for certain other varieties of fish, and for frogs. As soon as the spawn is hatched, the plate C is raised and the young shad pass out through the screen N. The case must only be opened after dark, for shad, as the smaller fish which would take the young shad only feed during the day. This gives the young shad an opportunity to take care of themselves as nature dictates.

The ends or sides, either or both, may be made of wire or cloth screens, with a bottom of the same, or it may be made close, but I prefer the construction principally shown and described. It will be seen that by this plan the spawn is all exposed to the circulation necessary, and is entirely relieved from all sediment or other obstructions or tendencies to prevent a perfect hatching.

What I claim as my invention, and desire to secure by letters-patent, is—

The employment or use of the fish-propagator or spawn-hatcher, constructed and arranged substantially in the manner and for the purposes herein shown and described.

SETH GREEN.

Witnesses:

WM. S. LOUGHBOROUGH.

FRED. A. HATCH.

To all whom it may concern:

Be it known that I, Marcellus G. Holton, of Rochester, in the county of Monroe, and State of New York, have invented certain improvements in pisciculture or fish-spawn hatching, of which the following is a specification:

The object of my invention is to provide a simple and convenient method of fish-spawn hatching, which may be practically carried on during the winter-season. Its nature consists, mainly, in the employment, in connection with the spawn-trays, of an upward current or flow of water through the layers of spawn, affording a thorough and constant circulation of fresh water through the same.

In the drawing, (Plate XIV, Figs. 1, 2, and 3,) Fig. 1 is a vertical central section of one case of trays; Fig. 2 is a top or plan view of the same; Fig. 3 is a transverse sectional view of the cylindrical bottom B.

A represents a square box or case, made water-tight, preferably of wood, and provided with a concave bottom, shown at B, or a hopper-bottom might do as well, the object being to cause any sediment, &c., to be easily removed through the discharge-pipe *p*. There is a channel, C, formed entirely around the case near the top. The outer walls of such channel are somewhat elevated above the upper edge of the case proper. This permits a gentle overflow from all sides of the tray-chamber, near the bottom of which is fixed a ledge, *i*, Fig. 1, upon which the trays *c* may rest. These latter consist of shallow rectangular frames, each provided with a fine wire-gauze bottom, upon which the spawn is deposited and held during the time of hatching. There is a suitable metallic or other strap, *s*, attached to two opposite sides of the bottom tray in each case of trays, whereby the whole set may be raised or lowered as may be necessary in removing or replacing them, as hereafter more fully described. There is a vertical recess cut in the sides of the case to receive the straps. The latter are perforated at distances corresponding to the vertical depth of each tray; and the straps, if made of metal, may be provided with a suitable pin, *a*; but if leather is used, they may be hooked upon a fixed pin in the upper edge of the case. A pipe, P, may be used to conduct the water from the spring or fountain into the bottom of the case; or a water-chamber may be formed entirely across that side of the case and also across the bottom. This latter construction is rather preferable for all except the first case in each tier, and, in fact, would not be objectionable for that. To insure a thorough distribution and circulation of the upward-flowing current of water through all parts of the trays, I provide the deflector *h*, which may be spherical, as shown, flat, or any other suitable shape. It is supported directly over the inlet-opening *d* upon suitable standards *n*. The discharge spout or trough *f* conveys the overflowing water to the descending water channel or chamber of the next succeeding case.

The case may be made of any desired size; but I prefer them about eighteen inches to two feet square, and from two to four feet or more in height, according to the amount of fall afforded to the water from the spring or fountain.

The cases may be arranged in tiers the whole length of the floor of the hatching-house, and the water overflowing from one made to pass into and through the next succeeding one to any desired extent as to numbers.

The lower tray is suspended, when it is to be filled, in the position occupied by the upper tray *c'*. The spawn is deposited evenly over the surface of the wire-gauze, and in a suitable quantity. The tray is then lowered by the straps *s* sufficiently to permit the insertion of another tray, which is treated in a like manner, and so on until the case is filled. The trays and young fish may then be removed in a similar manner—that is, one tray at a time—and the water allowed to flow through during either process.

It will be seen that the spawn will remain evenly distributed on account of the longitudinal position of the trays; and, by means of the buoyant tendency of the upward current, there is no damage or loss of spawn by lack of circulation.

This plan is intended more especially for winter-hatching, or for the spawn of white-fish; but it may also be used for almost any other kind.

What I claim as my invention is—

1. The spawn-hatching apparatus A, constructed as described, to produce an equally-distributed upward flow or circulation of the water, for the purposes set forth.

2. In combination with the spawn-hatching apparatus A, the overflow-channels C, arranged to equalize the overflow on all sides, substantially as and for the purposes set forth.

3. In a spawn-hatching device, the trays *c* and water-inlet opening *d*, in combination with the deflector *h*, arranged to operate substantially as and for the purposes shown and described.

4. In combination with the spawn-trays *c*, the concave or hopper-shaped bottom B, substantially as described, and for the purposes set forth.

M. G. HOLTON.

Witnesses:

WM. S. LOUGHBOROUGH.

PATRICK MCINTYRE.

Clark's tray-hatching apparatus.—Nelson W. Clark, of Clarkston, Michigan.—Improvement in fish-hatching apparatus.—(Specification forming part of letters-patent No. 148035, dated March 3, 1874; application filed January 7, 1874.)

To all whom it may concern:

Be it known that I, Nelson W. Clark, of Clarkston, in the county of Oakland, and State of Michigan, have invented an improvement in fish-hatching houses and boxes, of which the following is a specification:

The nature of this invention relates to new and useful improvements in the construction of hatching-boxes, and their arrangement in a hatching-house, and the arrangement of the other necessary parts to secure economy and safety in the manipulation of the eggs, and to preserve the fish after being hatched. The object of the invention is, first, to avoid the use of gravel as a hatching-bed, so that all danger of disturbing the eggs may be avoided, and which attends cleaning them from the deposit of silt or earthy matter, which, more or less, obtains when the gravel-beds are employed; second, to enable the manipulators to easily remove the dead eggs while immersed in water of the same temperature as is used in the hatching-troughs; third, to preserve the fish, when hatched, within the boxes wherein they were hatched, and whence they may be easily and safely removed, when desired; and, fourth, to not only save labor, but to insure the hatching of more eggs than in the hatching-troughs usually employed.

Fig. 1 is a plan view of a section of a hatching-house built upon my improved plan. Fig. 2 is a vertical section on the line *x x* in Fig. 1. Fig. 3 is a plan view of the cross-bar which retains the hatching-box in place in the troughs, and at the same time confines the perforated top of the hatching-boxes. Fig. 4 is a sectional perspective of one of the hatching-boxes with the perforated top or cover in place. Fig. 5 is a perspective of one of the water-ways or channels which leads from one compartment of the troughs to another. Fig. 6 is a perspective of an inverted hatching-box.

Like letters refer to like parts in each figure.

In the accompanying drawings, A represents the walls of a hatching-house, provided at one end with an elevated water-tank, B, from which the water flows through pipes or faucets *a a'*, as desired. C are the various compartments of the hatching-troughs, made water-tight, and the walls and divisions somewhat higher than the hatching-boxes D, and so provided with waste-water ways or channels *b* that the water in the troughs shall never flow over the tops of the boxes. These latter are constructed somewhat smaller than the compartments in the troughs wherein they are placed, and they are provided with feet *c* to raise them sufficiently from the floor of the troughs to allow a free passage of water under them, and to raise them above any sediment that may be deposited on said floor. The bottoms of these boxes are covered with a fine wire-gauze, sufficiently fine that the fish, when hatched, cannot pass through the meshes. Small risers *d* are secured to the ends of the boxes just above the bottom, and upon these bottoms are placed a portion of the eggs to be hatched. A series of sieves, E, the meshes of which are fine enough to retain the eggs placed therein, and large enough to per-

mit a free passage of the young fish, are successively placed, one above the other, in the boxes, until the same are nearly filled—each one of these sieves having its proportion of eggs deposited thereon. A pan, F, made of perforated sheet-metal, is then placed as a cover to prevent the eggs from floating. The hatching-boxes, being thus prepared, are placed one in each compartment of troughs C, and with one end resting against that side of the compartment whence the water is received. A cross-bar, G, is then inserted into small slots *e* in the sides of the troughs, and resting upon the tops of the boxes prevents them from floating when the troughs are partially filled with water. These cross-bars are provided with feet *f*, so adjusted that, when the bar is in place, the feet will rest against the perforated cover and prevent it from floating. When all the boxes have been thus placed and secured in the various successive compartments of the troughs, the water is let on through the pipes or faucets hereinbefore described as leading from the tank B, and falls on to the perforated covers of the boxes in the first compartments of the trough, and by means of the perforations in the covers is equally distributed over their surfaces, and runs down through the eggs upon the sieves below, supplying them with constantly-changing fresh water, and washing the eggs thoroughly, carrying down any sediment or impurity and depositing it upon the floor of the trough. As the first compartments fill with water, the waste-ways *b* allow it to pass on to and through the boxes in the next compartments of the trough, and so on, successively, until the water is finally discharged out of the hatching-house in any convenient way, and at the end opposite the tank. Great care must be taken to so arrange the waste-ways that the water will be discharged from one compartment into the next succeeding one before it reaches such a depth that it would flood or run over the sides of the hatching-boxes. At its lower end each one of these water-ways is provided with a perforated or wire-gauze screen, *h*, to prevent the possibility of the fish, when hatched, passing from one compartment to another. When the hatching is complete, the cover may be removed from the boxes and the young fish removed at will.

Many eggs, in the process of hatching, die, and it becomes necessary to remove the dead eggs to prevent injury to the others. To accomplish this, near each series of compartments there is placed a shallow trough, H, into which the water is fed from the tank B through the faucet *a'*, as shown. An operator removes one of the sieves from the hatching-boxes and places it in the trough H, through which the water of the same temperature flows from the tank, and of sufficient depth not to float the eggs. The dead eggs are removed in the usual way, and the sieve replaced in the hatching-box. The screen *h* is placed across the discharge-end of the water-ways, and is to prevent the small fish from ascending the current. Ordinarily screens are so placed and the hatching-troughs so arranged that the fish are carried down with the current against the screen, choking the same, and damming the water until it overflows, carrying with it great quantities of fish, which are thus lost.

By my plan of confining the fish, when hatched, to the boxes wherein they are hatched, they can never escape into the troughs, and, consequently, cannot get into the current through the waste-ways and choke the screens. The passage of the water down through the boxes is so broad, being the full size of the interior of the boxes, that the fish are not carried or forced downward, but they rise naturally, and these screens *h* are placed, as described, to prevent the fish from passing up the current.

What I claim as my invention, and desire to secure by letters-patent, is—

1. A fish-hatching house, wherein the water-tank B, hatching-troughs C, hatching-boxes D, cleaning-trough H, and water-ways *b* are constructed and arranged with relation to each other, substantially as and for the purposes herein set forth.

2. In combination with any suitable troughs, C, the hatching-boxes D, provided with feet, *c*, gauze-bottom sieves, E, and a perforated pan-cover, F, arranged to receive the water in the pan on top and discharge it below, substantially as and for the purposes specified.

3. The cross-bar G, constructed as described, in combination with the troughs C and hatching-boxes D, for the purposes set forth.

4. In combination with hatching-boxes, the perforated pan-cover F, as described, and for the purposes set forth.

NELSON W. CLARK.

Witnesses:

C. E. B. HUESTIS.

H. S. SPRAGUE.

Williamson's hatching-box.—[From the California Mining and Scientific Press, February 28, 1874.

To those persons engaged in fish-culture on a large scale, an improvement in hatching-boxes, recently perfected by Mr. John Williamson, secretary of the California Acclimatizing Society, will be of interest. We give an engraving of this box, which possesses some peculiar features. Mr. Williamson calls it the improved double-riffle hatching-box. Its special features can easily be seen by reference to the cuts. The upper figure shows a trough with light hatching-boxes, and the lower figure is a section of the box one-quarter of the full size. The usual way of arranging these hatching-boxes is to place the eggs on the bottom, and allow the water to flow over them. A box, the same size as the one represented, will then hold 20,000 eggs. Mr. Williamson puts in the box five trays 19½ inches long and 18 inches wide, with a frame three-quarters of an inch thick and one inch wide, with a wire bottom having eight squares to the inch. By this means, he has space to hatch 120,000 eggs, where he only had before, in the same box, space to hatch 20,000 eggs. This is of great importance in hatching-houses where room is desirable. The

hatching-box holding the trays is made of ½-inch ends and 1-inch bottom. The ends are 5 inches high. The water is made to flow in under the upper end and out over the lower end, as the arrows indicate. By this means all the eggs are thoroughly covered by constantly-changing water, and less sediment is deposited on the eggs. The end of each box near the head of the trough is made higher than the lower end, to cause the water to flow in the manner indicated. The trough is 16 feet long, 8 inches deep, and 18 inches wide. The longitudinal section is made on a scale of one-half inch to the foot.

Seth Green, the great fish-culturist, used a trough somewhat similar, but he led the water in and out of each box by means of a pipe, which caused a steady flow only near the mouth of the pipe. In Mr. Williamson's box, the flow is equal on all parts, and the eggs have plenty of fresh water. The upward current runs up through all the eggs, and the eggs being on top the sediment does not collect on them. There being so much more surface to place eggs in the same relative space, considerable room is saved in the hatching-house.

The California Acclimatizing Society are beginning to use these boxes at their hatching-house at Point Pedro, in San Mateo County. The device is not patented.

3.—THE BROOK-SHANTY.

An apparatus for fish-hatching, called the Brook-Shanty, was invented and patented by W. H. Furman, of Maspeth, Queens County, New York, in 1868.

This consists of a building, either inclosing a section of a stream with a dam shutting off the water from above, except as it passes through an inlet into the building, or without relation to a brook, admitting water from springs into the building. Within the building, raised above the inlet, a spawning "chamber" containing troughs is arranged. The troughs are covered with gravel to considerable depth. In front of the spawning-chamber is another dam or bulk-head that raises the water several inches above the gravel before it flows over; the water falls from the spawning-chamber into an apartment below called a receiver, the water being kept at a proper level by still another and a movable bulk-head below. Above the latter bulk-head a screen is placed to prevent the escape of young fishes down the stream. In the spawning season the lower bulk-head and screen are to be removed, permitting ripe fish to ascend until they find the gravel-beds in the spawning-chamber, where they are allowed to deposit their ova undisturbed, and are then permitted to drop down the stream. The troughs are provided with perforated lids to keep the light from the eggs.

The flow of water is from an inlet below the spawning-beds, the water passing up through the gravel-bed so as to be filtered and cleansed before it comes in contact with the eggs. It falls from the spawning-chamber into the receiver, where the young fishes are kept until strong

enough to protect themselves in the stream below, when they are allowed to pass the screen into the open waters.

The advantages Mr. Furman claims for his invention are, protection of the eggs and fish from their natural enemies and from sedimentary deposit and freshets. It has not as yet come into very general use.

E.—FROG-CULTURE.

By Seth Green.

There are many stagnant pools about the country, useless in their present state, and, believing that they should be utilized, I cannot think of any better use for them than to make them into frog-ponds. I believe that the man who could raise a million frogs, and get them to market, would be a rich man. He will find many difficulties to overcome; but allowing him two years for experimenting, good results might be anticipated.

1.—HOW TO GET THE SPAWN.

Take a large dipper and go to the pond where the frog casts its spawn. You will find them in a glutinous bunch. When you dip them up, be very careful not to break the glutinous matter which binds them together. Put them in a pail or can, filled with water, and take them to your hatching-box, which is made after the fashion of the shad-hatching box. It is a box two feet long, eighteen inches wide, and a foot deep, covered on the bottom with gas-tarred wire sieving, twelve wires to the inch. Anchor the box in a gentle current. They will hatch in from seven to fifteen days, according to the temperature of the water.

2.—HOW TO TAKE CARE OF THEM.

Soon after they are hatched, they should be turned loose in a pond prepared with great care, as they have numerous enemies, such as fish, snakes, birds, lizards, coons, and many other animals. The pond should be made where the ground is springy, and have plenty of soft muck in the bottom. In this muck the frog lies during the winter. The pond should have a tight board fence, so that no animals could get in, and should be built so close to the water that no bird could stand on the ground inside the fence and pick up the polliwogs. If you do not heed all these precautions, and more too, your young fry will all disappear down the stomach of some bird or animal; and if you are not an unusually close observer, you will be in great wonder where they have gone.

You will have no trouble in feeding the young while they are polliwogs; nature has provided for that in all waters. They feed upon microscopic forms found in the sediment. In all waters not impregnated with injurious minerals these forms of life are numerous. Put the sedi-

ment under a strong magnifying-glass, and you will see that it is nearly all animal matter, or a formation between animal and vegetable, and is the proper food for the young frog-fry. They will eat it off from the sticks and stones on the bottom of the pond, and keep them as clean as if they had been washed. An old pond is better than a new one, because it will have more food in it.

The above is as far as I have gone. I have lost my polliwogs, and know what became of them, and hope others may profit by a knowledge of the difficulties in the way.

When they have reached the condition of frogs they live on all kinds of insects. To provide them food the only way is to procure insects in quantities large enough to support a great number of frogs. One plan I had was to put any kind of meat or anything that would call flies and place it around the edge of the pond and on floating boards; flies would come and cast their eggs, and the frogs live on the flies and maggots. I think they could be taught to eat meat. They would certainly eat it if they once tasted it. The question is, how to get them to taste it. I have many times tied a small piece of meat on a fine thread and attached the thread to a long fish-rod and moved it about near the frog's nose, and he would take it very quick. But you could not afford to teach a million in this way. I think there might be some plan invented to teach them to eat meat; any contrivance that would give it a life-like appearance and movement, and not have the fixture so clumsy that it would frighten the frog before he made a snap at the meat, would answer the purpose. The frog takes his food with a snap. Frogs are an article of food to a great many. They used to be plentiful, but are now very scarce, owing to their being taken during the spawning-season, which is the only time they are taken, except a few that are taken out of the muck in the springs where they gather during the winter.